WFM7200
Waveform Monitor

Service Manual

077-0675-00

Tektronix

WFM7200
Waveform Monitor

Service Manual

Warning

The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

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077-0675-00

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- Worldwide, visit www.tektronix.com to find contacts in your area.

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Table of Contents

General safety summary iv
Service safety summary vi
Preface vii
Manual Conventions vii
Related Manuals vii
Introduction 1
Service Strategy 1
Specifications 1
Performance Verification 1
Options and Accessories 1
Configurations 1
Hardware Installation 2
Product Upgrade 2
Operating Information 2
Theory of Operation 3
Main Board 5
Front Panel 6
Composite Input Option CPS 6
Audio Options AD and DPE 6
Option PHY3 7
Fan Control 10
Power Supply and Distribution 10
Adjustments 11
Required Equipment 11
Procedures 11
General Maintenance 17
Preventing ESD 17
Inspection and Cleaning 18
Troubleshooting 21
Detailed Troubleshooting Procedures 26
Removal and Replacement Procedures 38
Preparation 38
Module Removal 40
Repackaging Instructions 47
Packaging 47
Shipping to the Service Center 47
Replaceable Parts 49
Parts Ordering Information 49
Using the Replaceable Parts Lists 50

List of Figures

Figure 1: Main block diagram 4
Figure 2: Option PHY3 block diagram 9
Figure 3: Main board power supply test points and LEDs 35
Figure 4: Audio Main board power supply test point locations 36
Figure 5: Analog audio board power supply test point locations 37
Figure 6: Module securing screws 41
Figure 7: Front panel and fan cable connections 44
Figure 8: Front panel disassembly 44
Figure 9: Front panel board removal 45
Figure 10: Circuit boards and connectors 53
Figure 11: Chassis components 55
Figure 12: Main board replaceable components 57
Figure 13: Analog audio breakout cable assembly 58

List of Tables

Table i: Related documentation vii
Table 1: External inspection checklist 19
Table 2: Internal inspection checklist 19
Table 3: Required test equipment 22
Table 4: Symptoms and causes 23
Table 5: Main board secondary supplies 28
Table 6: Audio main board secondary supplies 29
Table 7: Analog audio secondary supplies 29
Table 8: Tools required for module removal 39
Table 9: Module removal 40
Table 10: Circuit boards and connectors (See Figure 10.) 51
Table 11: Chassis components (See Figure 11.) 54
Table 12: Replaceable parts list (See Figure 12.) 56
Table 13: Replaceable parts list (See Figure 13.) 58
Table 14: Accessories 59

General safety summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

To avoid fire or personal injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

Ground the product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Power disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

Do not operate without covers. Do not operate this product with covers or panels removed.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

Provide proper ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Terms in this manual

These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols and terms on the product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:

Service safety summary

Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

Do not service alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect power. To avoid electric shock, switch off the instrument power, then disconnect the power cord from the mains power.

Use care when servicing with power on. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Preface

This manual supports servicing to the module level of the WFM7200 Waveform Monitor, which process video signals for display on an internal XGA LCD. The instrument finds use as a monitor for broadcasting, production, and post-production environments.

This manual explains how to troubleshoot and service the monitor to the module level. The manual is divided into the following sections:

- *Introduction* provides a general product description and tells where to find product installation information.
- *Theory of Operation* provides descriptions of the WFM7200 Waveform Monitors modules.
- *Adjustment Procedures* details the adjustments that to perform if the instrument is out of specification.
- *Maintenance* tells you how to troubleshoot the product to the module level and how to handle the modules.
- *Replaceable Parts* illustrates the replaceable modules and mechanical parts, and provides replacement part numbers.

Manual Conventions

The following terms and conventions are used throughout this manual:

- The term “instrument” is used interchangeably with the more formal term “WFM7200 Waveform Monitor.”

Related Manuals

This manual assumes you have access to the following manuals when servicing this product. These manuals ship with the product and can also be downloaded from the Tektronix Web site.

Table i: Related documentation

Item	Purpose	Location
WFM7200 Waveform Monitor User Manual	Operation instructions and explanation of features	Product Documentation CD www.tektronix.com/downloads
WFM7200 Waveform Monitor Installation and Safety Instructions, English, Japanese, Simplified Chinese	Basic installation and safety information	Printed manual Product Documentation CD www.tektronix.com/downloads
WFM7200 Online Help	In-depth operation and UI help	In the instrument: press the HELP button on the front panel

Table i: Related documentation (cont.)

Item	Purpose	Location
WFM7200 Waveform Monitor Specifications and Performance Verification	Procedure for checking performance and list of specifications	Product Documentation CD www.tektronix.com/downloads
WFM and WVR Series Management Information DataBase (MIB)	Programmers command reference for controlling the waveform monitor	Product Documentation CD www.tektronix.com/downloads

Introduction

The WFM7200 Waveform Monitor provides a powerful monitoring solution for broadcast, production, and post-production environments.

Service Strategy

These products are repaired to the module level at selected Tektronix service centers. Repair includes functional verification of the product. Component level repair by the customer is not supported.

Specifications

The specifications for this product are found in the *WFM7200 Waveform Monitor Specifications and Performance Verification Technical Reference* located on the Product Documentation CD that ships with the product and is published on the Tektronix Web site. (See page vii, *Related Manuals*.)

Performance Verification

The Performance Verification procedures for this product are found in the *WFM7200 Waveform Monitor Specifications and Performance Verification Technical Reference* located on the Product Documentation CD that ships with the product and is published on the Tektronix Web site. (See page vii, *Related Manuals*.)

Options and Accessories

The lists of options and accessories for this product are found in the *WFM7200 Waveform Monitor User Manual* located on the Product Documentation CD that ships with the product and is published on the Tektronix Web site. (See page vii, *Related Manuals*.)

Configurations

The base instrument accepts an optional module for Analog Composite inputs (Option CPS). Other options add audio capability, Eye diagram and physical layer analysis, jitter analysis capability, and advanced gamut monitoring capability. For a complete list of options, refer to the *WFM7200 Waveform Monitor User Manual*.

Hardware Installation

The instrument is shipped in a wrap-around chassis which covers the instrument bottom and two sides. A cover is installed on the chassis, and the rear panel is made up of the module rear panels. You can operate the waveform monitor in the instrument chassis (the top cover must be installed, for safety and for proper cooling), or installed in an approved portable cabinet or rack adapter. You can also install the instrument in a custom installation, such as a console. For installation instructions, refer to the *WFM7200 Waveform Monitor Installation and Safety Instructions* or the Rack Adapter Instructions included with your Tektronix rackmount kit.

Product Upgrade

Hardware and software upgrades are available for all products, either as a field upgrade kit or as a free software download from the Tektronix Web site. The *WFM7200 Waveform Monitor User Manual* includes instructions for updating product software.

Operating Information

For operating instructions, refer to the *WFM7200 Waveform Monitor User Manual*. For more detailed reference information, refer to the instrument Online help. (Press the **Help** button on the instrument front panel and then use the **General** knob, up/down arrow keys, and **SEL** button to navigate through the topics.)

Power-On Procedure

1. Connect the supplied power cord to the rear-panel power connector.
2. Press the power button on the instrument front-panel and the instrument will turn on.
3. Wait for the system to complete its power-on self-tests.

NOTE. *The Standby button on the front-panel does not disconnect mains power. Only the power cord at the rear of the product can disconnect mains power.*

Power-Down Procedure

1. Press the power button on the instrument front-panel to turn the instrument off.
2. To remove power completely, disconnect the power cord from the rear-panel of the instrument.

Theory of Operation

The WFM7200 is a modular waveform monitor. They can be configured, with options, to accept Analog Composite inputs. Audio options can add inputs for digital only or analog audio capability.

All models use an internal DVI-I monitor for the display, and have an output to drive an external monitor with the same display. All models also have outputs to drive serial digital and analog picture monitors.

This theory of operation is mainly based on the High-level Block diagram. (See Figure 1.) When necessary, other block diagrams may also be referenced.

The lower portion of the block diagram covers functions on the main board. The upper sections cover those of the optional video input and audio boards.

The primary functions on the main board are:

- Serial digital input processing
- Reference input
- Waveform processing engine
- Rasterizing, recursion, and picture processing engine
- Control processor and its associated peripherals
- Auxiliary and ancillary data processing
- Secondary power distributions

There are also miscellaneous circuits, such as the thermal control system for the fan.

Power Distribution is not shown in the block diagram but is covered at the end of this section.

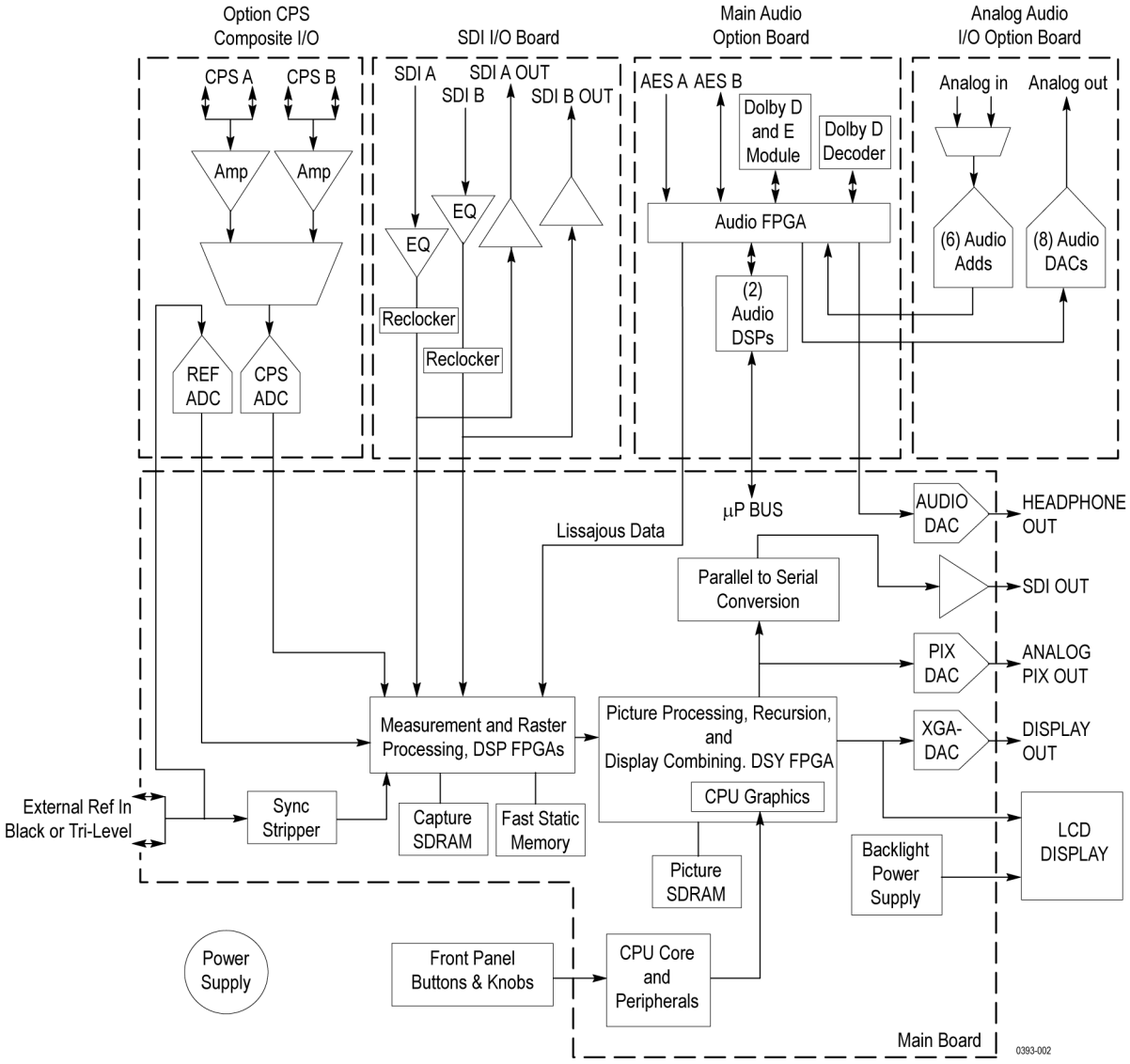

Figure 1: Main block diagram

Main Board

Serial Digital Input Processing

The serial digital circuitry receives the SDI input streams after they have been equalized, from either the SDI I/O board or the PHY3 board, depending on the installed options. The SDI streams are passed to the DSP FPGAs where they undergo measurement and raster processing. The signal information is then passed to the DSY FPGA for picture processing, recursion, and display combining. The result is shown on the LCD display, and also provided to the external DVI-I connector.

Reference Input

The Reference input is a passive loopthrough, which is AC coupled and buffered. Operation varies, depending on whether the instrument is operating in digital or composite input mode. For digital inputs the reference signal is applied to a sync separator whose output is supplied to the DSP FPGA, where the timing information is derived. For composite inputs, the reference signal is routed to the Option CPS composite input board, where a 10-bit ADC digitizes the signal. The digitized signal is then routed back to the DSP FPGA on the main board so the timing information can be derived, as with the digital process.

Digital Waveform Processing Engine

The data streams from the Composite and SDI video inputs are applied to the waveform processing FPGA. This block deformats, up-samples, interpolates, demodulates, and otherwise processes the data to generate the signals needed to create the displays.

Rasterizing Engine

The Rasterizer engine resides in the same DSP FPGA as the waveform processing engine. This block builds up the variable intensity images in the fast static RAM. For each pixel of the display, the Rasterizer Engine increments the intensity of that pixel every time the waveform hits its coordinates. As a result the waveform areas hit more frequently are brighter. For any given frame, the intensity map is built up in one memory chip and read out of the other. The functions swap on the next field.

Recursion and Picture Processing Engine

The output of the rasterizer feeds the picture and recursive processing engine in the second large FPGA. This engine adds the previous frame to the present frame to reduce flicker and improve brightness. It also converts the picture and waveform signals from the input rate of 50 or 59.94 Hz to 60 Hz frame rate to work with the DVI-I monitor. The picture and waveform data combine with the graphics and audio bar information from the control processor, and then output to the XGA DAC to drive the external monitor. Note that the parallel data from the serial digital inputs connect directly to this FPGA to provide the picture functionality, bypassing the waveform processing engine.

Control Processor

The control processor is in charge of all the operational modes in the instrument. It draws the audio bars, communicates with the front panel, and controls most other internal devices though either the SPI or the I²C bus. Audio data is input to the control processor via the 8 bit HPI bus.

The control processor interfaces to the Ethernet through a dual rate connection. This allows the network connection to run at 10 or 100 MBps.

LTC

LTC inputs come from the remote connector. The LTC signal is applied to an A/D converter and then input to the waveform processing FPGA, which decodes the time code information.

NOTE. *The FPGAs decode VITC signals digitally.*

Front Panel

The front panel contains a small processor which communicates with the control processor through SPI signaling. Reprogramming can be done through the SPI if the front panel processor flash code must be updated.

Composite Input Option CPS

The Composite inputs are also passive loop-throughs. If unterminated, the signal appears twice as large as it should. The inputs are either AC or DC coupled, depending on the DC Restore setting. The selected input signal is filtered and applied to an A-to-D converter to generate a 14-bit parallel signal, which is routed to the DSP FPGA on the Main board, where it is demodulated in the digital domain.

Audio Options AD and DPE

The audio option (if installed) resides in the module slot closest to the power supply. There are two audio options available.

- Option AD adds Analog Audio Monitoring (2 sets of 6 channel Analog Audio inputs and 8 channels of Analog Audio outputs) and 16 channels Embedded and AES/EBU Digital Audio support (8 channels at a time). This option is available for all models.
- Option DPE adds Option AD capabilities plus support for decoding and monitoring Dolby E and Dolby D Audio. This option is available for all models.

Audio Processing

Both audio versions have the same basic processing engine. This uses an FPGA to route the audio input into two DSP chips, whose main function is to calculate the peak values for the selected meter ballistics (response characteristics).

The audio data has two paths to the display. On one path, peak values are sent to the control processor which then plots the bar and surround displays. On the second path, raw data samples are sent to the waveform processing engine which interpolates and plots it to generate the lissajous, or "phase," display.

Audio Inputs

There are three basic audio input paths: AES, analog, and embedded. AES inputs are accepted at rates up to 192 kHz.

Analog inputs are digitized at 48 kHz and then go through the same path as the AES inputs.

The embedded audio path starts at the waveform processing engine. First the audio samples are extracted from the serial digital video data using a 12.288 MHz oscillator and sent to the audio board. At the audio board the streams are multiplexed into the AES decoders and then follow the same path as the AES data. The user can choose to have the de-embedded audio output on the AES B port.

Audio Outputs

There are two audio outputs: Analog and AES. Both outputs always follow the source that is currently selected for the audio bar display. The analog outputs can come from any input. The selected signal output from the FPGA is converted from digital to analog, and then sent as a balanced output to the 62-pin rear panel analog audio connector.

The AES B connectors can be configured as outputs for use with any input type. They can serve as an active loopthrough if the input is AES, a de-embedder if the input is embedded, or an A/D converter if the input is analog. Up to six decoded Dolby audio channels may be output if Option DPE is installed.

Option PHY3

Option PHY3 provides the following features:

- Eye pattern display
- Equalized Eye pattern display
- Jitter readout
- Jitter Meter
- Cable Loss readout
- Test Signal Output
- Approx Cable readout

- Source Level readout
- Jitter waveform display [1]
- Eye Amplitude readout [1]
- Eye Risetime readout [1]
- Eye Falltime readout [1]
- Eye Rise-Fall (difference) readout [1]

[1] Requires Option PHY3.

NOTE. *SD, HD, and 3 Gb/s signals can be used with these features. All instrument models come standard with SD-SDI and HD-SDI. 3 Gb/s signals require Option 3G be installed.*

The hardware to support these features is contained on the PHY3 board. The Audio blocks are not shown in this block diagram but, if installed, still connect as shown in the Main Block diagram. (See Figure 1 on page 4.)

Operation

Each SDI input signal is applied to a cable equalizer. The selected input signal is sampled by a wide-band track-and-hold circuit, and then digitized. The selected input is also applied to a clock recovery circuit. The recovered clock is divided by 10 for SD (by 20 for HD), filtered to form a sine wave, and then digitized. Both the SDI input and the recovered clock sine wave are sampled by the same asynchronous clock, and then both are passed to the main board for processing by FPGAs. These arrays produce the Eye Display, Jitter Display, Jitter Readout, and Jitter Thermometer. The Eye Display data is further processed to derive the Eye Amplitude, Eye Rise Time, and Eye Fall Time measurements, which are shown in the SDI Status Display.

The selected SDI input signal also drives the Cable Meter circuit, which measures signal energy at two frequencies. These measurements are read by the CPU on the Main board, which calculates Cable Loss, Approximate Cable Length, and Source Level for display in the SDI Status screen.

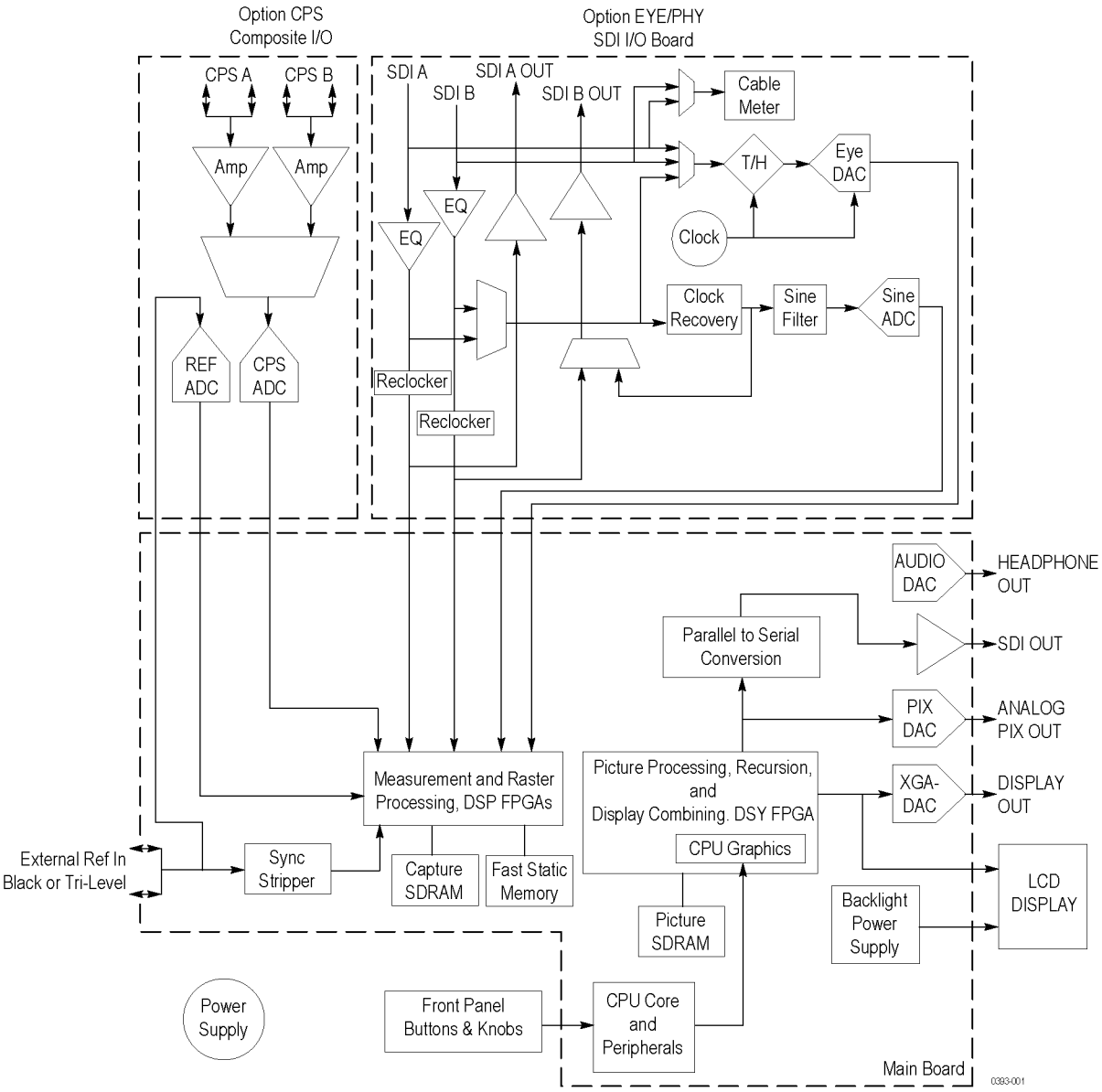

Figure 2: Option PHY3 block diagram

Fan Control

There are multiple temperature sensors in different locations in the instrument, including some mounted on the option boards. The control processor reads the temperature sensors and sets a target speed for the fans. The fan circuit holds the fan speed at the target by measuring the fan tachometer output, allowing reliable operation at low speed. If a fan is not turning, the circuit senses the stall and turns on a red LED (DS11 or DS12 on the Main board). The fans are tested at power on. If a fan fails, a message is shown on screen and also entered into the diagnostic log.

Power Supply and Distribution

The power supply has a universal AC input, enabling it to accommodate 90 to 264 VAC without any user range switching. The output is 5 VDC. Circuits convert this output to any other supply voltage that they require at the point of usage.

Fuses on the Primary supply 5 V output protect the main board.

The secondary supplies and their tolerances are specified in the troubleshooting section. The location of the supply test points is shown in the *Maintenance* section.

Adjustments

The waveform monitor does not normally require any adjustments. The adjustments which can be made are semi-automated, and should only be made while performing a Performance Verification. Make the appropriate adjustment if the instrument fails one of these tests in the Performance Verification procedure:

- *Cable Meter (HD, SD, and 3G)* (Option PHY3 only)
- *Jitter Noise Floor* (Option PHY3 only)
- *Eye Gain* (Option PHY3 only)
- *PixMon Output*
- *Composite Analog Input DC Offset Restore Off* (Option CPS only)
- *Composite Analog Vertical Measurement Accuracy* (Option CPS only)
- *Composite Analog Frequency Response* (Option CPS only)
- *Analog Audio Level Meter Accuracy Over Frequency* (Options AD and DPE only)

After making the adjustment shown here, repeat the failed Performance Verification step.

Required Equipment

These adjustment procedures require the same equipment as the Performance Verification procedure. For more details refer to *Specifications and Performance Verification*.

Procedures

NOTE. *If you do not see the calibration case you are looking for, make sure to go to the next page using the up or down arrow key.*

Cable Meter

1. If any cable length reading is outside the specification, perform the following adjustment procedure. Perform both the Short and Long steps for any input (SDI A or SDI B) and any standard (HD, SD, and 3 Gb/s) that was found to be outside the specification.

NOTE. Be sure to use a generator with SDI output set as close as possible to 800 mV, since the Cable Meter adjustment establishes the Source Level and the Approx Cable (cable length) calibration.

2. Press **CONFIG**, select **Utilities** > **Calibration**, and then press **SEL** to start the calibration process.
3. Use the up and down arrow buttons to navigate to the Cable Meter calibration case you want.
4. Press **SEL** to start, and follow the on-screen instructions.
5. Follow the instructions at the bottom of the screen to Save and Exit Calibration mode.

SD, HD, and 3G Clock Extractor (Jitter Noise Floor)

If the Jitter Noise Floor is outside of the specification, perform the Eye CDR Null calibration, as described below.

1. Press the **CONFIG** button.
2. Select **Utilities** > **Calibration** and press **SEL** to enter the Calibration menu.
3. Use the arrow buttons to navigate to the appropriate Eye CDR Null calibration case.
4. Press **SEL** to start, and follow the on-screen instructions.
5. Follow the instructions at the bottom of the screen to Save and Exit Calibration mode.
6. Restart the Jitter Noise Floor test, and then record the new values in the test record provided in the Specifications and Performance Verification manual.

Eye Gain

If the Eye Gain is outside the specification, perform the following adjustment procedure for SDI A and SDI B inputs.

1. Connect a signal source, with an 800 mV, 1 MHz, square wave signal to the SDI A input. Make sure the source is calibrated and the signal amplitude is within a few millivolts of 800 mV.
2. Press the **CONFIG** button, and then select **Utilities** > **Calibration**. Press **SEL** to enter the calibration menu.
3. Use the up and down arrow buttons to navigate to the appropriate Eye Gain Adjust selection, and press **SEL** to start the calibration.

4. Follow the on screen instructions, using the General knob or the up and down arrow keys to adjust the displayed amplitude of the eye waveform until it is 800 mV.
5. Press and hold **STATUS**, and then select **SAVE** and press **SEL**.
6. Repeat for the SDI B input.
7. Follow the instructions at the bottom of the screen to Save and Exit Calibration mode.

PixMon YPbPr Gain

1. Connect a signal with an identifiable 100% level, such as 100% Flat Field or 100% Color Bars, to the SDI A input.
2. Connect an XGA to 5x BNC adapter cable to the PixMon output.
3. Connect the Y/Green video signal to the oscilloscope input. (Use an oscilloscope with a 75 Ω input, or a 75 Ω feed through termination.)
4. Set the Oscilloscope:

Control	Setting
Vert	200 mV/Div
Horiz	20 µs/Div
Trigger	Edge

5. Press the **Config** button.
6. Select **Utilities** > **Calibration**. Press **SEL** to enter the calibration menu.
7. Navigate to the **Pixmon YPbPr Gain** calibration case, and press **SEL** to start.
8. Adjust the oscilloscope trigger level for a stable display.
9. Use the General knob to adjust the signal amplitude (not including the sync pulse) to 700 mV on the oscilloscope.
10. Follow the instructions at the bottom of the calibration screen to Save and Exit Calibration mode.

PixMon YRGB Black Level

1. Connect a signal with an identifiable black level, such as 0% Flat Field or 100% Color Bars, to the SDI A input.
2. Connect an XGA to 5x BNC adapter cable to the PixMon output.
3. Connect the Y/Green video signal to the oscilloscope input. (Use an oscilloscope with a 75 Ω input, or a 75 Ω feed through termination.)

4. Set the Oscilloscope:

Control	Setting
Vert	200 mV/Div
Horiz	20 µs/Div
Trigger	Edge

5. Press the **Config** button.
6. Select **Utilities** > **Calibration**. Press **SEL** to enter the calibration menu.
7. Navigate to the **Pixmon YRGB black level** calibration case, and press **SEL** to start.
8. Adjust the oscilloscope trigger level for a stable display.
9. Use the General knob to adjust the signal black level to 0 V on the oscilloscope.
10. Follow the instructions at the bottom of the calibration screen to Save and Exit Calibration mode.

PixMon PbPr Zero Level

1. Connect a signal with an identifiable black level, such as 0% Flat Field or 100% Color Bars, to the SDI A input.
2. Connect an XGA to 5x BNC adapter cable to the PixMon output.
3. Connect the Pb/Blue video signal to the oscilloscope input. (Use an oscilloscope with a 75 Ω input, or a 75 Ω feed through termination.)
4. Set the Oscilloscope:

Control	Setting
Vert	200 mV/Div
Horiz	20 µs/Div
Trigger	Edge

5. Press the **Config** button.
6. Select **Utilities** > **Calibration**. Press **SEL** to enter the calibration menu.
7. Navigate to the **Pixmon PbPr zero level** calibration case, and press **SEL** to start.
8. Adjust the oscilloscope trigger level for a stable display.
9. Use the General knob to adjust the signal zero level to 0 V on the oscilloscope.
10. Follow the instructions at the bottom of the calibration screen to Save and Exit Calibration mode.

Composite Analog Input DC Offset Restore Off (Option CPS)

Perform the following steps if the Offset is outside the specification.

1. Press the **Config** button.
2. Select **Utilities** > **Calibration**, and then press **SEL** to enter the calibration menu.
3. Navigate to **Composite DC Offset** and press **SEL** to automatically adjust the offset.
4. Follow the instructions at the bottom of the screen to Save and Exit Calibration mode.

Composite Analog Vertical Measurement Accuracy (Option CPS)

Perform the following steps if the Amplitude is outside the specification.

1. Connect a 100% color bar signal from the precision generator to the Composite A input. Terminate the loop through with a precision 75 Ω termination.
2. Press the **CONFIG** button.
3. Navigate to **Utilities** > **Calibration**, and then press **SEL**.
4. Select **Composite Waveform Gain**, and then press **SEL**.
5. Follow the on-screen instructions to adjust the gain.
6. Follow the instructions at the bottom of the screen to Save and Exit Calibration mode.

Composite Analog Frequency Response (Option CPS)

Perform the following steps if the Frequency Response is outside the specification.

1. Connect the precision video generator to one of the CMPST A input connectors and terminate the other connector with the precision terminator.
2. Set the precision generator for 700 mV Multiburst. The top packet must be 5.75 MHz.
3. Press the **CONFIG** button.
4. Navigate to **Utilities** > **Calibration**, and then press **SEL**.
5. Select **Composite Freq Peak** and then press **SEL**.
6. Follow the on-screen instructions to adjust the response.
7. Follow the instructions at the bottom of the screen to Save and Exit calibration mode.
8. Repeat the Composite Analog Frequency Response test in the Performance Verification procedure.

Analog Audio Level Meter Accuracy Over Frequency

If any of the Analog A Inputs failed to meet the specification, (or even if they are off by more than a few tenths of a dB) the following input adjustment can be performed.

1. Set the analog audio generator as follows:

Control	Setting
Frequency	1 kHz
Output Level	18 dBu Audio Tone
Output Impedance	10 Ω

2. Connect the generator balanced (BAL) analog output to the Analog A input that requires adjustment.
3. Press the **CONFIG** button.
4. Navigate to **Utilities** > **Calibration**, and then press **SEL**.
5. Push the up or down arrow key until the desired Analog Audio input channel is highlighted, and then press **SEL**.
6. Follow the instructions at the bottom of the screen to Save and Exit calibration mode.
7. Check for an indication of 18 dBu in the newly adjusted audio bar.
8. If multiple inputs require adjustment, repeat this procedure for each input.
9. After all adjustments are made, you should perform a complete performance verification procedure.

General Maintenance

This section contains the information needed to perform periodic and corrective maintenance on the instrument. The following subsections are included:

- *Preventing ESD* – General information on preventing damage by electrostatic discharge.
- *Inspection and Cleaning* – Information and procedures for inspecting and cleaning the instrument.
- *Troubleshooting* – Information for isolating and troubleshooting failed modules. Included are instructions for operating the diagnostic routines and troubleshooting trees. Most of the trees make use of the internal diagnostic routines to speed fault isolation to a module.
- *Removal and Replacement Procedures* – Information and procedures for removing and replacing modules in the instrument.
- *Repackaging Instructions* – Information on returning a instrument for service.

Preventing ESD

Before servicing this product, read the *Safety Summary* and *Introduction* at the front of the manual, and the ESD information below.

CAUTION. *Static discharge can damage any semiconductor component in the instrument.*

When performing any service that requires internal access to the instrument, adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive circuit boards and components.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive boards.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Service static-sensitive modules only at a static-free work station.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Handle circuit boards by the edges when possible.

6. Do not slide the circuit boards over any surface.
7. Avoid handling circuit boards in areas that have a floor or work-surface covering capable of generating a static charge.

Inspection and Cleaning

Inspection and Cleaning describes how to inspect for dirt and damage. It also describes how to clean the exterior and interior of the instrument. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent malfunction and enhance reliability.

Preventive maintenance consists of visually inspecting and cleaning the instrument and using general care when operating it.

How often maintenance should be performed depends on the severity of the environment in which the instrument is used. A proper time to perform preventive maintenance is just before any instrument adjustment.

General Care

The cabinet helps keep dust out and should normally be in place during operation.

WARNING. *To prevent injury or death, power off the instrument and disconnect it from line voltage before performing any procedure that follows.*

Interior Cleaning

Use a dry, low-velocity stream of air to clean the interior of the chassis. Use a soft-bristle, non-static-producing brush for cleaning around components. If you must use a liquid for minor interior cleaning, use a 75% isopropyl alcohol solution and rinse with deionized water.

Exterior Cleaning

Clean the exterior surfaces of the chassis with a dry lint-free cloth or a soft-bristle brush. If any dirt remains, use a cloth or swab dipped in a 75% isopropyl alcohol solution. Use a swab to clean narrow spaces around controls and connectors. Do not use abrasive compounds on any part of the instrument that may damaged by it.

CAUTION. *Avoid the use of chemical cleaning agents that might damage the plastics used in the instrument. Use only deionized water when cleaning the front-panel buttons. Use a glass cleaner to clean the LCD. For the rest of the instrument, use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

Inspection – Exterior. Inspect the outside of the instrument for damage, wear, and missing parts, using the following table as a guide. Immediately repair defects that could cause personal injury or lead to further damage to the instrument.

Table 1: External inspection checklist

Item	Inspect for	Repair action
Cabinet, front panel, and cover	Cracks, scratches, deformations, damaged hardware	Repair or replace defective module
Front-panel knobs	Missing, damaged, or loose knobs	Repair or replace missing or defective knobs
Connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors	Repair or replace defective modules. Clear or wash out dirt
Carrying handle and cabinet feet	Correct operation	Repair or replace defective part
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors	Repair or replace damaged or missing items, frayed cables, and defective modules
LCD	Cracks	Replace the LCD assembly
	Dirty	Clean with glass cleaner

Inspection – Interior. To access the inside of the instrument for inspection and cleaning, you will need to remove the top cover.

Inspect the internal portions of the instrument for damage and wear, using Table 4-2 as a guide. Defects found should be repaired immediately.

If any circuit board is repaired or replaced, see if it is necessary to adjust the instrument. (See Table 2 on page 19.)

CAUTION. *To prevent damage from electrical arcing, make sure that circuit boards and components are dry before applying power to the instrument.*

Table 2: Internal inspection checklist

Item	Inspect for	Repair action
Circuit boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove and replace damaged circuit board.
Resistors	Burned, cracked, broken, blistered condition.	Remove and replace damaged circuit board.

Table 2: Internal inspection checklist (cont.)

Item	Inspect for	Repair action
Solder connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Remove and replace damaged circuit board.
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

Cleaning Procedure – Interior. To clean the instrument interior, perform the following steps:

1. Blow off dust with dry, low-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint-free cloth dampened in isopropyl alcohol (75% solution) and rinse with warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)

   STOP. *If, after doing steps* 1 *and* 2*, a module is clean upon inspection, skip the remaining steps.*
3. If steps 1 and 2 do not remove all the dust or dirt, the instrument may be spray washed using a solution of 75% isopropyl alcohol by doing steps 4 through 6.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels.
5. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Dry all parts with low-pressure, deionized air.

Lubrication. There is no periodic lubrication required for the instrument.

Troubleshooting

The procedures in this section will help you trace the root cause of a problem back to one of the replaceable modules. In general, this is a board-level replacement but there are a few components on some boards that are replaceable.

WARNING. *Before performing this or any other procedure in this manual, read the General Safety Summary and Service Safety Summary found at the beginning of this manual.*

To prevent possible injury to service personnel or damage to electrical component, refer on how to prevent ESD. (See page 17.).

Getting Started

This procedure consists of two main sections: the first section contains the *Symptoms and Causes* table, and the second section contains a set of *Detailed Troubleshooting Procedures*. The table lists common problems and should help you identify the problem or it may direct you to one of the detailed troubleshooting procedures in the second section. If you do not find your instrument's problem in the table, or if no specific problem was reported by the user, then follow the steps in the *Unknown Problem* section in the Symptoms and Causes table.

The WFM7200 Waveform Monitor is highly configurable and its behavior is sometimes complex. Before troubleshooting in-depth, verify that:

- The installed options are as expected. See CONFIG > Utilities > View Instrument Options
- The current settings support the expected behavior. A good first step is to recall the Factory Presets. To do this, press PRESET > Recall Preset > Recall Factory Preset.

To properly test this instrument, you must have appropriate signal sources. Depending on what portion of the instrument you are testing, this might include Composite video, Serial Digital Video, Analog Audio, or Digital Audio. In some cases, you may also need receivers or an oscilloscope to check outputs.

These instruments consist of several boards and major components. Some of these are optional, as shown below. The objective of this troubleshooting guide is to isolate a problem to a module or board so it can be replaced. This guide does not provide information to troubleshoot to the component level.

Standard boards and modules:

- Power Supply
- Display Assembly (LCD, Front Panel board with buttons, LEDs, and knobs)
- Main board

Optional boards:

- SDI input, for instruments without Option PHY3
- Eye, for Option PHY3
- Composite input, for Option CPS
- Audio Main, for Option AD and DPE
- Analog Audio, for Options AD and DPE
- Dolby Decoder module, for Option DPE

Table 3: Required test equipment

Test equipment	Requirements	Example
SDI serial digital video test generator with embedded audio and composite signal source. Varies with installed options: SD - Need SD SDI source HD - Need HD SDI source 3 Gb/s - Need 3 Gb/s SDI source CPS - Need composite SDI source	1080p 59.94 3 Gb/s HD signals required: ■ 100% color bars ■ SDI Matrix Split Field Pathological Signal	Tektronix TG700 with an HD3G7 module (Embedded audio needed for audio options)
	1080i 59.94 HD signals required: ■ 100% color bars ■ 10 bit shallow ramp ■ SDI Matrix Split Field Pathological Signal ■ 100% sweep	Tektronix TG700 with HDVG7 module (Embedded audio needed for audio options)
	525/270 SD signals required: ■ 100% color bars ■ 10 bit shallow ramp ■ SDI Matrix Pathological Signal ■ 100% sweep	Tektronix TG700 with DVG7 module (Embedded audio needed for audio options)
	Composite signals required for Option CPS: NTSC SMPTE bars	Tektronix TG700 with AVG7 module
XGA Monitor	Computer monitor capable of 1024 x 768 x 60 Hz scan rate	
AES Audio Signal Generator (If any audio option installed)	48 kHz, 24 bit word length signals	Rohde & Schwarz UPV, Tektronix AM700 and AM70.
Analog Audio Signal Generator (If any audio option installed)		Rohde & Schwarz UPV, Tektronix AM700 and AM70.
Voltmeter		Fluke 87 or equivalent
DC Ammeter with Clamp on pickup	20 Amp DC capable	Fluke 336 or equivalent
Oscilloscope	Video trigger capability	Tektronix TDS3000C Series, Tektronix DPO70404

Table 4: Symptoms and causes

Symptom	Possible Sources or Recommended Detailed Troubleshooting Procedure to follow
No LEDs lit and/or LCD not working	Perform general checks Perform primary power supply checks Perform secondary power supply checks Perform Front Panel button Troubleshooting Perform LCD troubleshooting test Replace main circuit board or Front Panel assembly as indicated by above tests
Inconsistent or partial hardware failures	Perform primary power supply checks Perform secondary power supply checks Examine Power-up Diagnostics results in the Diagnostic Log Run Advanced Diagnostics Replace Main circuit board
Fails any of these Power On Diagnostics: ■ Main Board Option ■ Main Board Power Supplies ■ Main Board Sensor ■ Main Board Serial EEPROM ■ Main Board Serial FLASH ■ DSP FPGA A/B COMM ■ DSP FPGA A/B Program ■ Display FPGA COMM ■ Display FPGA Program	Review messages in diagnostic log Perform primary power supply checks Perform secondary power supply checks Run Advanced Diagnostics and look for other information Replace the main board
Fails any of these Power On Diagnostics: ■ Composite DAC Comm: ■ Composite SPI Comm: ■ Front Panel Version Information	Review messages in diagnostic log Perform primary power supply checks Perform secondary power supply checks Run Advanced Diagnostics and look for other information Replace the Composite board

Table 4: Symptoms and causes (cont.)

Symptom	Possible Sources or Recommended Detailed Troubleshooting Procedure to follow
Fails any of these Power On Diagnostics: ■ Eye Hardware Revision ■ Eye Board Cable Version ■ Eye Register Readback ■ Eye Board Power Supply ■ Eye Board Cal EEPROM	Review messages in diagnostic log Perform primary power supply checks Perform secondary power supply checks Run Advanced Diagnostics and look for other information Replace the EYE/PHY board
Failures while running the advanced diagnostics: ■ DSP1 QDR1 Memory 1 ■ DSP1 QDR2 Memory 2 ■ DSP2 QDR1 Memory 1 ■ DSP2 QDR2 Memory 2 ■ DSY DDR Buffer 1 Memory ■ DSY DDR Buffer 2 Memory ■ DSY DDR Trig Buffer Memory ■ DSY SDRAM Buffer 1 Memory ■ DSY SDRAM Buffer 2 Memory	Perform secondary power supply checks Replace main board
Diagnostic Log Message: ■ Fail AUDIO_DSP_HEARTBEAT	Search for an intermittent problem in the audio board, cables, or main board.
No text or traces on LCD	Perform LCD troubleshooting test
Traces on LCD but not on Ext Display output	Replace Main board

Table 4: Symptoms and causes (cont.)

Symptom	Possible Sources or Recommended Detailed Troubleshooting Procedure to follow
Functional Test Failures Performance Verification Test Failures	In case of failure on either Functional or the Performance tests, the board at fault is generally obvious. Before replacing a board: 1. Perform the primary and secondary power supply checks. 2. Run the advanced diagnostics and check the diagnostic log for help in isolating the fault. If this does not isolate the problem, then replace the main board if the test is in one of the following areas: ■ SDI ■ Composite ■ Ref ■ LTC ■ XGA output ■ Color Palette ■ Remote I/O ■ Ethernet If the problem is only the SDI input, first replace the SDI or PHY3 board (depending on option). If that does not fix the problem replace the main board. If the problem is Composite, replace the composite option board. If the problem persists then replace the main board. If the problem is in the audio board, first check the diagnostic log for audio power-up self test failures or audio DSP programming failures. If the problem persists, replace the audio board.
Unknown Problems An instrument may come into service with vague or intermittent symptoms. In a case like this, the following set of tests may help find the problem or the marginal condition.	1. Check the diagnostic log. This log records a variety of problems and will enable you to see messages for an error that may not be currently happening. 2. Check the power supplies by performing the Primary and Secondary Supply checks. A marginal supply can lead to intermittent operation if it is near the acceptable threshold. This includes the main supply and the secondary supplies on each board. 3. Perform the incoming inspection tests. This will exercise a majority of the functions in the unit and includes the advanced diagnostics. Some parts of the test may not be necessary for all problem areas. 4. If the unit has an audio board, remove it and recheck any problem areas in the video performance. The Audio board can place too much of a load on the supplies if they are marginal. If the performance changes with the audio board removed, then you should perform the primary and secondary power supply checks and look for an excess load on one of the supplies.

Detailed Troubleshooting Procedures

The following tests should be run as indicated in the *Symptom and Causes* table. (See Table 4 on page 23.). The procedures check for specific problems or will help you isolate a problem to a board. You can run them at any time for informational purposes but if you do not run the procedures in the correct context, then the final recommendation identifying a root cause might be suspect.

General Checks

1. Verify that the power cord is connected.
2. Check that all internal cables are correctly connected and seated.
3. Check for any discolored or burned components.

Fan Failures

This instrument contains two fans, They are controlled by both hardware and software. Hardware controls the fans to a certain speed, but software sets the speed target as a function of the temperature measured on a variety of temperature sensors.

If a fan fails, its corresponding LED on the Main board lights.

- Fan 1 fails: LED DS12 lights
- Fan 2 fails: LED DS11 lights

A fan failure is sensed through tachometer feedback; a fault will be asserted if the fan is not connected, is stalled, or if the tachometer feedback line is not working correctly.

If one fan fails, the control circuit will increase the voltage to the 13.5 V max level, causing the remaining fan to run at maximum speed.

The normal voltage to drive the fans (pin 1) varies from about 6 V to 13.5 V depending on temperature and the options installed on the instrument.

If a fan is not spinning, measure the voltage on pin 1 of the connector on that fan. If the voltage is near 13 V, then replace the fan. If the voltage is not above 10 V, then replace the main board.

If both fans are spinning, but either LED DS11 or DS12 is lit, the problem is probably the tachometer feedback line on pin 3 of either fan. Inspect the wiring and resistors R637, R635, R638, and R636 on the main board, and use the oscilloscope to look for a 3.3 V square wave on the tachometer feedback line. Replace the affected fan if resistors are intact but there is no signal on the tachometer line.

Primary Power Supply Tests

This section describes methods for verifying the proper operation of the primary power supply.

WARNING. *Some parts of this test may require removing the insulating safety shield. To avoid personal injury, be careful not to contact the circuitry while the shield is removed. Be sure to replace the shield as soon as possible to prevent injury.*

The main power supply accepts 90 to 264 VAC and outputs 3 DC voltages: +5 V main, +5 V standby, and +12 V. The +5 V standby is always present and powers the on/off switch and the reverse voltage shutoff circuit. The +5 V main and +12 V supplies are turned on or off by the front panel power button.

There is a green LED, DS19, that will be lit if some 5 V power is present. This is a useful indicator, but does not ensure that the voltage is within tolerance. There are also several red LEDs that provide information on the health of other supplies on the board. DS5 is a red LED that lights when the fused +5 V supply is low. DS6 lights when the +3.3 V supply is low, and DS7 indicates when the +1.5 V supply is low.

If the main power supply output is correct, between 4.80 V and 5.25 V (measured at connector J22), check the eight fuses in the 5 V system near the main board power connector J22. (See Figure 3 on page 35.). All should have 5 V on both sides. If not, replace the fuse.

If the main power supply output voltage is zero (measured at J22 pin 1), then check the AC input circuit. The AC voltage should be the same at the line cord, at the input to the power supply, and on both ends of the fuse on the input to the supply. If the input voltage is not correct at any point, replace the element in the chain that is not passing the AC input. If the input voltage is correct, check the +5 V standby supply at connector J25 pin 2. If the standby supply is zero, then replace the main power supply. If it is between +4.5 V and +5.5 V, check the power supply inhibit line at J25 pin 5. If the power supply inhibit line is low, then replace the main power supply. If the power supply inhibit line is high, and the unit does not respond to a front panel power button press, then try a new front panel. If that does not correct the problem, there may be a main board failure in the power switch circuit.

If the voltage at the output of the supply is not zero, but still not correct, check the input voltage. If the input voltage is in the correct range, then disconnect the cable at J22 from the main board and recheck the output voltage. If the voltage is still not correct then replace the power supply.

If the no-load output voltage is correct, then reattach the cable to the main board and measure the current by clamping the ammeter around the red wire. If the current is less than 20 Amps, and the voltage is still bad, then replace the power supply. If the current is more than 20 Amps, then remove module boards and recheck the current. If it is still high then replace the main board. If not then test with one option board at a time to find the one with excess current and replace that board.

Secondary Power Supply Tests

There are multiple secondary supplies that are derived from the main 5 V supply. Be sure all eight 5 V fuses are good (as noted in *Primary Power Supply Tests*) before checking the secondary supplies.

First, check the LEDs near the rear left side of the instrument. Green LED DS19 indicates there is some 5 V from the main supply.

Next, check if any of the three Red LEDs (DS5, DS6, or DS7) are on. These indicate failures on the general 5 V, general 3.3 V, and processor 1.5 V supplies, respectively. If these are lit, the most likely causes are the fuses near J14, but if those are all OK replace the main board.

Next, check the secondary supplies as shown in the table. (See Table 5.) Each supply has a test point in the rear left corner of the Main board. (See Figure 3 on page 35.) If any supplies are out of range, replace the main board.

Table 5: Main board secondary supplies

Nominal (+V)	Allowed range (+V)	Labeled as
1.8	1.7 to 1.9	+ 1.8 V
Fan	5 to 13.5	FAN_PWR
+5	4.75 to 5.25	+ 5 V
3.3	3.2 to 3.4	+ 3.3 V
2.5	2.4 to 2.6	+ 2.5 V
1.5	1.4 to 1.6	+ 1.5 V
1.0	0.95 to 1.05	+ 1.0 V
+5A	4.75 to 5.25	+ 5 VA
-5A	-4.75 to -5.25	– 5 VA
1.2	1.2 to 1.4	+ 1.2 V

Check the Audio supplies on the Audio board (if an Audio board is installed). (See Table 6 on page 29.). The test points are available with the board installed. (See Figure 4 on page 36.).

Table 6: Audio main board secondary supplies

Supply name	Range	Measured at
+1.5 V	1.425 to 1.575	TP6
+3.3 V	3.1 to 3.6	TP8
-5 V	-4.5 to -5.5	TP9
+5 V	4.75 to 5.2	TP10
+1.26 V	1.20 to 1.32	TP11
+1.8 V	1.71 to 1.89	TP95

Check the secondary supplies on the Analog audio board, if installed. This is the smaller audio card to which the 62 pin DSUB connector is mounted. The test points are available, with the board installed, along the top front edge of the board. (See Figure 5 on page 37.).

Table 7: Analog audio secondary supplies

Supply name	Range	Notes
+15 V	14 to 15.5	TP901
–15 V	–14 to -15.5	TP803
+5 VD	4.8 to 5.2	TP5
+5 VA	4.8 to 5.2	TP3
+3.3 V	3.1 to 3.6	TP2
–5 V	–4.5 to -5.5	TP1

The PHY3 board also has multiple secondary supplies, and test points along the top edge where they can be probed. The Power-up Diagnostics measure these, so they are not included in this procedure. Note that some of these supplies are only active in either SD or HD mode, so it is normal for some of them to not be present in some operating modes.

Front Panel Button Troubleshooting

Perform this test if the power supplies are good, but none of the buttons are lit or respond to presses.

1. Cycle the power to the unit. Immediately after power on, three buttons (GAIN, SWEEP, and MAG) should be lit continuously and the other buttons should be lit one at a time in a walking pattern.
2. If the buttons are not lit, check the 10 pin cable from the keypad to the main board J21. If the cable is connected and good then replace the front panel assembly.

LCD Troubleshooting

Perform this test if there is no display on the LCD, but the power supplies test as nominal.

1. Connect an external XGA monitor to the “Display” output on the rear of the instrument.
2. Cycle the power and watch the external monitor. If the monitor does not display the boot up messages and normal operational screen, replace the main board.
3. If the external monitor does show the nominal screen, check the gray ribbon cable from the internal display to J17 on the main board. This carries the XGA data to the display.
4. If the gray ribbon cable is OK, check to see if the backlight is on. Look into the vent holes along the left side of the bezel while you cycle the power. You should see the backlight come on when power is reapplied. It may help to be in a low light area to see the backlight.
5. If the backlight is on, replace the front panel assembly.
6. If the backlight is not on, check the backlight power cable from the backlight inverter (on the rear of the display assembly) to the main board J18. Also check connector J18 itself for any solder issues.
7. If the backlight is still bad, replace the front panel assembly – although there is still a small chance the problem is in the main board.

Audio Power-Up Diagnostic Failure

It is sometimes difficult to isolate the root cause of audio problems. Most audio problems are due to faults on the audio board, but the audio board communicates with the main board, so in some cases the problem may be there as well.

Audio Power-up Diagnostic Detailed Information. The Power-up Diagnostic does the following:

- Reads all of the AES decoder internal registers and verifies that what is read is correct
- Reads all of the D/A internal registers and verifies that what was read is correct
- Performs an active-bit test on the A/D output clocks
- Checks the serial EEPROM to see which of the analog inputs have been calibrated
- Tests the Audio DSP/FPGA interface
- The main CPU detects if the DSP heartbeat fails. This condition will be shown in the diagnostic log

For audio boards, not all errors are reported by the power on diagnostics. Therefore, if you are detecting a loss in audio functionality, check the diagnostic log for any reported audio errors. If any errors are found, perform the following procedure to narrow the problem to either the audio board, the main board, or the connection between them.

1. Prepare a test oscilloscope with the following settings:

Control	Setting
Vertical Scale	2.00 V/div
Horizontal Scale	5.00 µs/div

2. If the diagnostic log contains an entry that reads **Fail Audio DSP Self Test fpga**, do the following substeps:

   a. Check audio board DS511, the FPGA programmed indicator in the Main board power supply test points and LEDs. (See Figure 3 on page 35.). If this LED is off, skip to step b; otherwise probe pin D21 of connector J641 of the Audio board (the connector to the Main board) during the boot sequence. If the signal on the pin toggles, replace the main board; otherwise, replace the audio board.

   b. Probe pin D20 of J641 on the audio board during the boot sequence. If the signal does not exhibit a low-to-high transition, replace the main board.

   c. Probe pins A11 and B11 of connector J641 during the boot sequence. If the signal on either of these pins does not toggle, replace the main board.

   d. Probe pin D19 of J641 on the audio board during the boot sequence. If the signal does not exhibit a low-to-high transition replace the audio board.

   e. If all signals in a through d are correct replace the audio board.

3. If the Diagnostic Log screen reports the failure **Audio DSP Self Test-dsp0**, perform the following procedure:

   a. Check to see if the audio board is recognized by the main board by pressing the **Main** button, then **CONFIG** and selecting **Utilities > View HW/SW Version**.

   b. If there is an audio option listed, suspect the audio board; otherwise, proceed to step c.

   c. Probe pins E15 through E22 and pins D16, 17, 18, and C17 on the audio board connector J641, and verify that the signals on all pins are toggling. If any signals are not toggling, replace the main board.

   d. Probe pins C15, C16, and C18 on connector J641 during boot up and verify that the signals toggle. If they are not toggling, suspect the main board.

e. Probe pin B21 on audio board connector J641 during the boot sequence. If the signal does not toggle, replace the audio board; otherwise, replace the main board.

f. If all of these steps pass, replace the audio board.

4. If the Diagnostics log reports **Audio DSP Self Test-dsp1**, perform the following procedure:

a. Check to see if surround display is functioning correctly by doing the following.

i. Press and hold the **Audio** button.

ii. In the audio menu, select **Aux Display** > **Surround Display**.

iii. Press the **Audio Input** Menu button, then select **Audio Input** > **AES A**.

iv. Connect an AES test tone generator to the AES A IN 1, 2 connector.

b. If there is nothing displayed on the surround display, proceed to step c; otherwise, replace the audio board.

c. Probe pins E15 through E22 and pins D16, 17, 18, and C17 on audio board connector J641, and verify that the signals on all pins are toggling. If any signals are not toggling, replace the main board.

d. Probe pins C15, C16, and C19 on connector J641 during the boot sequence, and verify that the signals on the pins toggle. If they do not toggle, suspect the main board.

e. Probe pin B22 on audio board connector J641. If the signal on the pin does not toggle, replace the audio board; otherwise replace the main board.

f. If all of these steps pass, replace the audio board.

5. If the Power-Up Diagnostics screen reports **Audio DSP Self Test - X**, where X is any other number or string, replace the audio board.

Examine Power-Up Diagnostics Results in the Diagnostic Log

To examine the Power-up Diagnostics results, press the **CONFIG** button, then select **Utilities** > **View Diagnostic Log**.

Each power on is indicated by a boot time stamp, followed by a list of power on tests. If any failures are indicted then refer to the action as noted above.

Run Advanced Diagnostics

To run the Advanced diagnostics, press the **CONFIG** button, then select **Utilities** > **Run Advanced Diags**.

Advanced Diagnostics includes tests that check interfaces between FPGAs and memory on the Main board. If any of these tests fails, replace the Main board.

Isolating Lissajous Display Errors

The audio Lissajous phase display uses a serial data path between the audio and main boards. A failure in this data path can be due to a problem on either board.

Perform the following tests to isolate the problem to one board or the other.

1. Prepare a test oscilloscope with the following settings:

Control	Setting
Vertical Scale	2.00 V/div
Horizontal Scale	200 ns/div

2. Check the Lissajous bus clock by performing the following substeps:
   a. Put the oscilloscope probe on pin B3 of connector J641 on the audio board. Verify the signal is ≈3 V_{p-p} and is a continuous 50% duty-cycle squarewave.
   b. If the signal at J641 is not as described in step a, the audio board most likely has a failure; otherwise, replace the main board.
3. Check the Lissajous bus frame and data signals by performing these substeps:
   a. Put the oscilloscope probe on connector J641 pin B2 of the audio board and verify the signal is ≈3 V_{p-p} and toggles low at regular intervals.
   b. If the signal on pin B2 looks OK, put the oscilloscope probe on pin B4. Pin B4 is the data line and the signal will have a somewhat random look depending on the audio source. Just verify that the signal is toggling and is ≈3 V_{p-p}.
   c. If either signal looks bad at J641 the audio board most likely has a failure, otherwise replace the main board.

Option PHY3 Troubleshooting

The PHY functions depend on the PHY3 and Main boards, and the interconnections between them.

Major Operational or Diagnostic Failure.

- Check that the 110 pin CPCI connector between the PHY3 and Main boards is correctly seated and secure.
- Check that the ribbon cable from the PHY3 board to the main board is securely plugged into J5 on the PHY3 board and J16 on the main board.

Eye Pattern or Jitter Waveform Display Problems. Jitter waveform display is only available with Option PHY3. The Eye Pattern and Jitter Waveform displays are formed from data sampled from the input signal and the recovered clock sine wave. Eye display bandwidth, rise and fall time, and transient response aberrations are controlled by circuits contained on the PHY3 board.

Cable Loss, Approx Cable, and Source Level Readout Problems. These measurements are made by a "cable meter" circuit. This circuit is located on the PHY3 board, but is largely independent from the Eye and Jitter display and measurement functions. If other PHY3 functions operate correctly, then a "cable meter" circuit problem is indicated. Replace the PHY3 board.

Jitter Readout and Jitter Meter Problems. These measurements are derived from sampled recovered clock sine wave data. Operation is unlikely to fail if the basic Eye pattern display works correctly. Measurement accuracy is not adjustable, but jitter noise floor depends on adjustment of Eye HD CDR calibration items.

Eye Amplitude, Eye Risetime, Eye Falltime, and Eye Rise-Fall (difference) Readout Problems. These readouts are only available with Option PHY3. These readouts are derived from the Eye pattern display. Measurement accuracy depends on the Eye Gain calibration items, and on front-end bandwidth and transient response, which are not adjustable. Operation is unlikely to fail if the basic Eye pattern display works correctly.

It is normal for these measurements to stop or become intermittent if there is excessive waveform noise, aberrations, jitter, or cable loss.

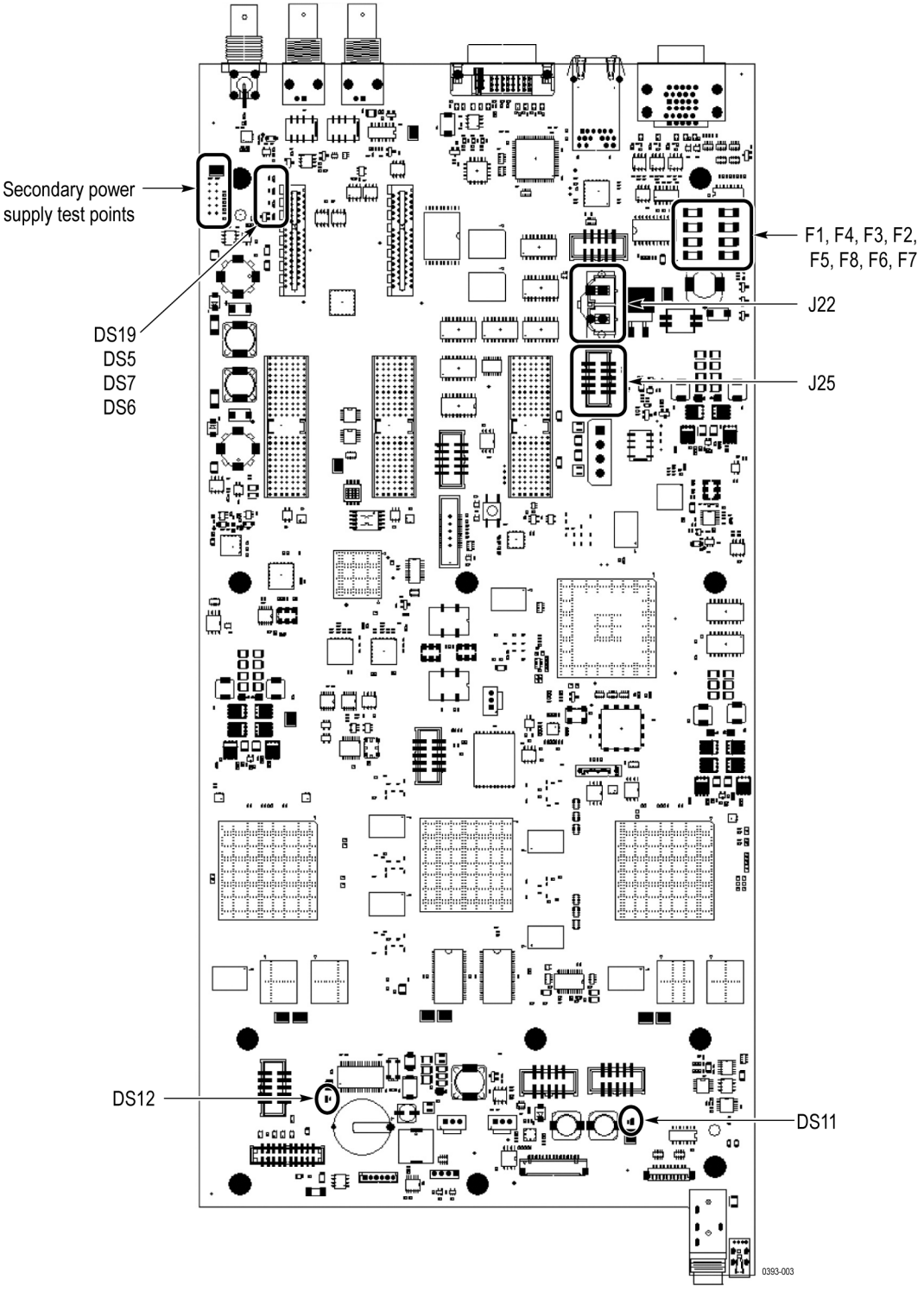

Figure 3: Main board power supply test points and LEDs

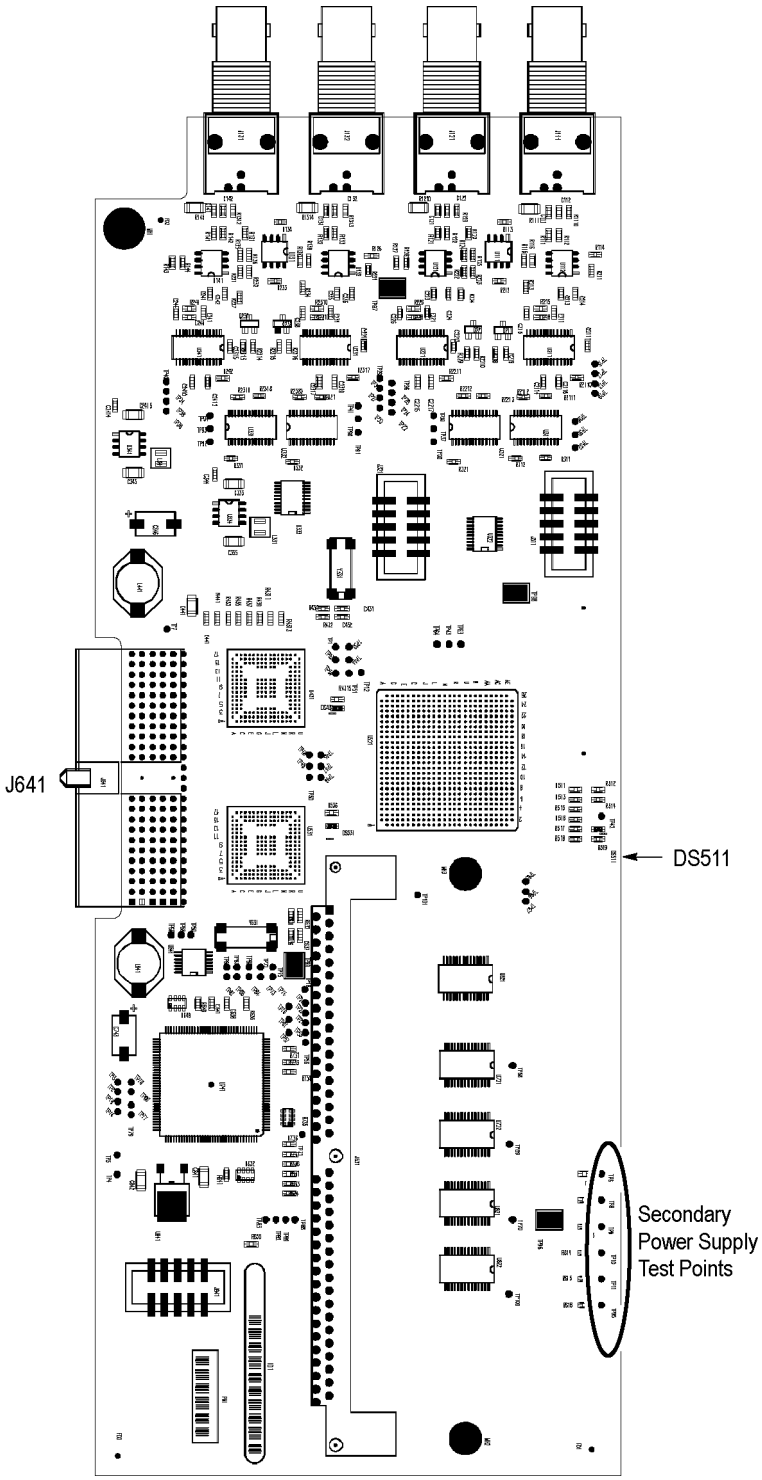

Figure 4: Audio Main board power supply test point locations

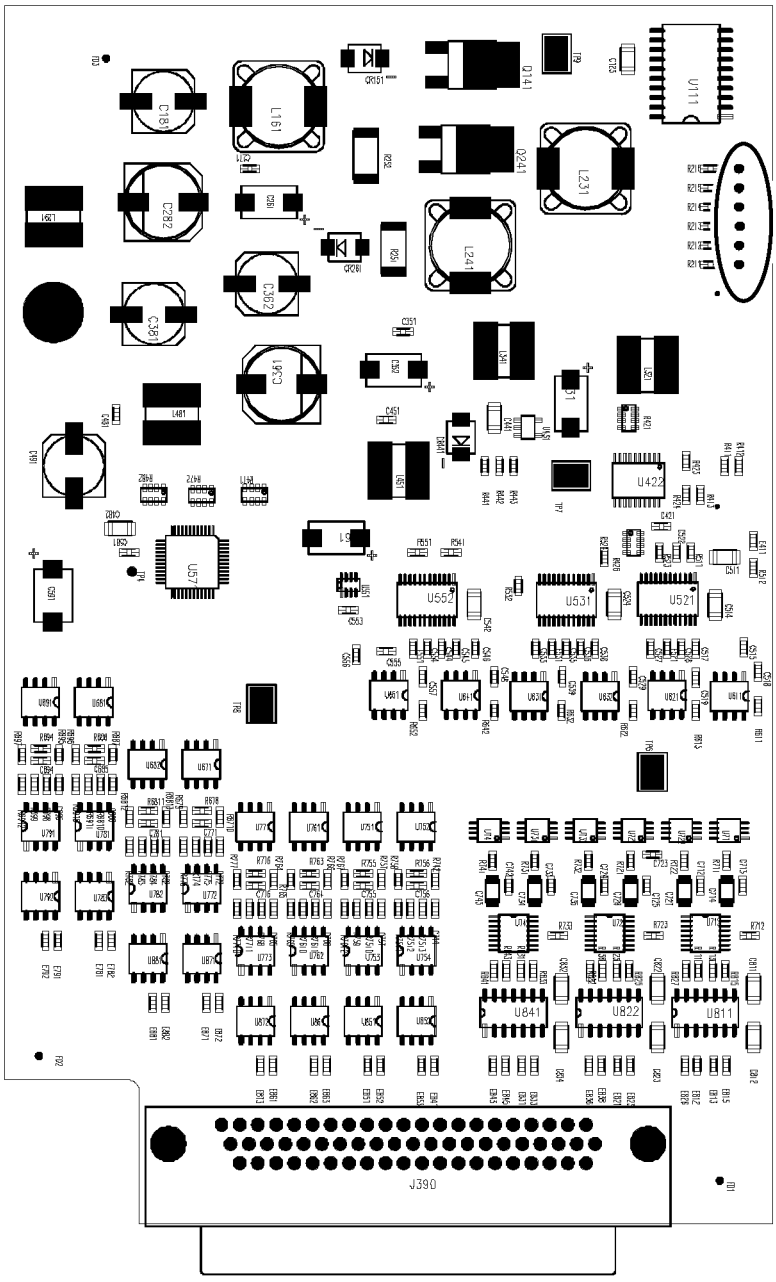

Figure 5: Analog audio board power supply test point locations

Removal and Replacement Procedures

This section contains information about removal and replacement of all modules in the waveform monitor.

Preparation

WARNING. *Before doing this or any other procedure in this manual, read the safety summaries found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to the instrument components, read Installation in Section 2, and Preventing ESD in this section.*

This subsection contains the following items:

- This preparatory information that you need to properly do the procedures that follow.
- List of tools required to remove and disassemble all modules.
- Procedures for removal and reinstallation of the modules.

WARNING. *Before doing any procedure in this subsection, disconnect the power cord from the line voltage source. Failure to do so could cause serious injury or death.*

NOTE. *Read Equipment Required for a list of the tools needed to remove and install modules in this instrument. (See Table 8 on page 39.) Read the cleaning procedure before disassembling the instrument for cleaning.*

Equipment Required. Most modules in the instrument can be removed with a screwdriver handle mounted with a size T-10, Torx screwdriver tip. All equipment

required to remove and reinstall the modules is listed in the following table. (See Table 8 on page 39.)

Table 8: Tools required for module removal

Item no.	Name	Description	General Tool number
1	Screwdriver handle	Accepts Torx-driver bits	620-440
2	T-10 Torx tip	Used for removing most instrument screws. Torx-driver bit for T-10 size screw heads	640-235
3	T-15 Torx tip	Used for removing instrument screws. Torx-driver bit for T-15 size screw heads	640-247
4	1/8 inch flat-bladed screwdriver	Screwdriver for unlocking cable connectors	Standard tool
5	Angle-Tip Tweezers	Used to remove front panel knobs	Standard tool
6	$^{3}/_{16}$ inch nut driver	Used to remove jack screws and front panel standoffs	Standard tool
7	$^{5}/_{16}$ inch nut driver	Used to remove nut on AC ground lug	Standard tool
8	MA-800G Soldering Aid (spudger)	Used to remove the front panel trim	Standard tool
9	Bomar DB36400	Special BNC socket wrench with Controlled Torque. Used to remove Audio board BNCs	– – – – –
10	Soldering iron (15 W)	Used for replacing Main board fuses	Standard tool
11	Long nose pliers	Used to compress connector lock tabs	Standard tool

Module Removal

The removal of most of the modules is a straightforward process, and can be determined by a quick study of the exploded diagrams in the *Replaceable Parts List*. The following table shows what to remove to access each module. (See Table 9 on page 40.)

Table 9: Module removal

	To remove						
You must first remove	**Composite**	**SDI/PHY**	**Audio assy**	**Power supply**	**Main**	**Bezel/ front panel board**	**Front panel/ LCD assy**
Top cover	X	X	X	X	X	X	X
Board supports	X	X	X	X	X		
Composite					X		
SDI/PHY					X		
Analog audio				X	X		
Audio main				X	X		
Main board							
Power supply					X		
Fan assembly					X		
Front panel/LCD assembly					X	X	
Bezel/front panel board					X		

Top Cover

The top cover is a slip-lock design.

1. Remove the six T-10 screws at the top cover front corners.
2. Remove the four T-10 screws securing the top cover to the rear panel.
3. Slide the top cover back approximately ½ inch and then lift it from the chassis.

Board Supports

The board supports span the width of the instrument chassis, holding the tops of the module circuit boards in place.

1. Remove the two T-10 screws securing each board support, and then lift them from the chassis.
2. When reinstalling the board supports, make sure that the module circuit boards line up with the slots in the board supports.

Rear Panel

The rear panel is formed by the chassis and the individual module rear panels, which overlap and are bolted together. (See Figure 6 on page 41.)

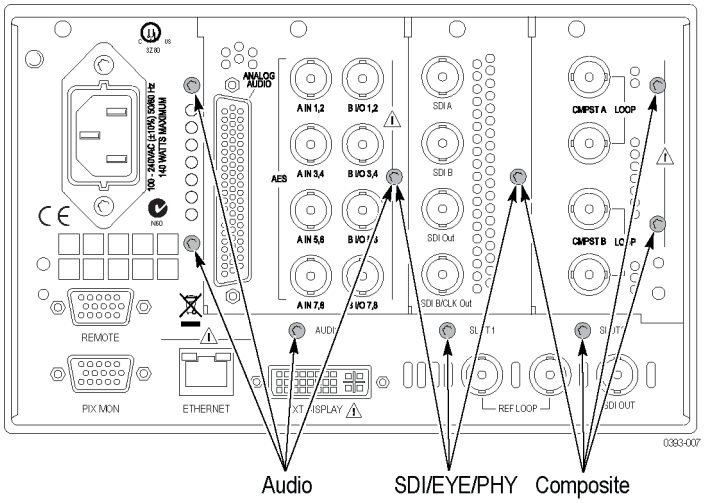

Figure 6: Module securing screws

Composite Board (Option CPS)

The Composite board, if installed, is located in the right module bay. (See Figure 6 on page 41.)

1. Remove the four T-15 screws securing the Composite module to the rear panel.
2. Lift the Composite module out of the instrument, rocking it gently until the connector separates from J20 on the Main board. It may help to loosen the adjacent rear panel screws.

SDI or PHY board

The SDI board (or PHY board if Option PHY3 is installed) is located in the right center module bay. (See Figure 6 on page 41.)

1. Remove the three T-15 screws securing the module to the rear panel.
2. Lift the module out of the instrument, rocking it gently until the connector separates from J16 on the Main board. It may help to loosen the adjacent rear panel screws.

Audio Boards (Options AD and DPE)

The Audio option boards, if installed, are located in the left center module bay, near the power supply. (See Figure 6 on page 41.)

DPE board. The circuit board for Option DPE may be removed without removing the entire Audio module.

1. Unsnap the spring clips at each end of the DPE circuit board.
2. Tilt the top of the DPE board away from the Audio Main board.
3. Lift the DPE board out of the instrument.

Analog Audio and Audio Main boards. Remove the entire Audio module as a unit. If necessary, the two boards may be separated.

1. Remove the four T-15 screws securing the Audio module to the rear panel.
2. Lift the Audio module out of the instrument, rocking it gently until the connector separates from J4 on the Main board. It may help to loosen the adjacent rear panel screws.
3. Use a $^{3}/_{16}$ inch nutdriver to remove the jackscrews securing the ANALOG AUDIO connector on the rear panel you just removed.
4. Remove the special nuts securing the eight audio BNC connectors to the rear panel.

NOTE. *Special nuts are used on the BNC connectors due to the close physical spacing, and a special tool is needed to remove them. (See Table 8 on page 39.)*

5. Remove the Audio module rear panel from the two circuit boards.
6. Separate the Audio module circuit boards at J130.

Power Supply

You may want to remove the audio board module first for increased clearance, but it is not required.

1. Disconnect the brown, blue, and green/yellow primary wires from the line filter. (See Figure 10 on page 53.)
2. Disconnect the green/yellow ground wire from the chassis, using a $^{5}/_{16}$ inch nutdriver. (See Figure 10 on page 53.)
3. Disconnect the 10-pin cable from J14 on the Main board.
4. Disconnect the two wire cable from J22 on the Main board.
5. From outside the instrument, remove the four T-10 screws securing the power supply shield to the chassis.
6. Lift the power supply out of the chassis.

7. Disconnect the line filter cable from CN1 on the power supply.
8. The power supply is secured to the shield by two screws and two posts. Remove the two T-15 screws.
9. Lift the power supply off of the two posts and out of the shield.

Fan Assembly

Remove the fans and baffle as a unit.

1. Remove the two T-10 screws, one on each side of the instrument chassis, that secure the baffle to the chassis.
2. Use long nose pliers to compress the lock tab on the connector, and disconnect the fan power cables from J11 (Fan #1) and J12 (Fan #2) on the Main board. (See Figure 7 on page 44.)
3. Lift the baffle out of the instrument.

Front Panel/LCD Assembly

Remove the front panel and LCD assembly as a unit. For additional clearance you may remove the Fan assembly first.

1. Remove the six T-10 screws that secure the front panel assembly to the chassis, two on each side and two on the bottom.
2. Pull the front panel assembly forward, being careful of the Main board extension containing the headphone and USB connectors, until they clear the LCD bracket.
3. Disconnect the cables connecting the Front panel/LCD assembly to the Main board at J27, J31, and J21. (See Figure 7 on page 44.)

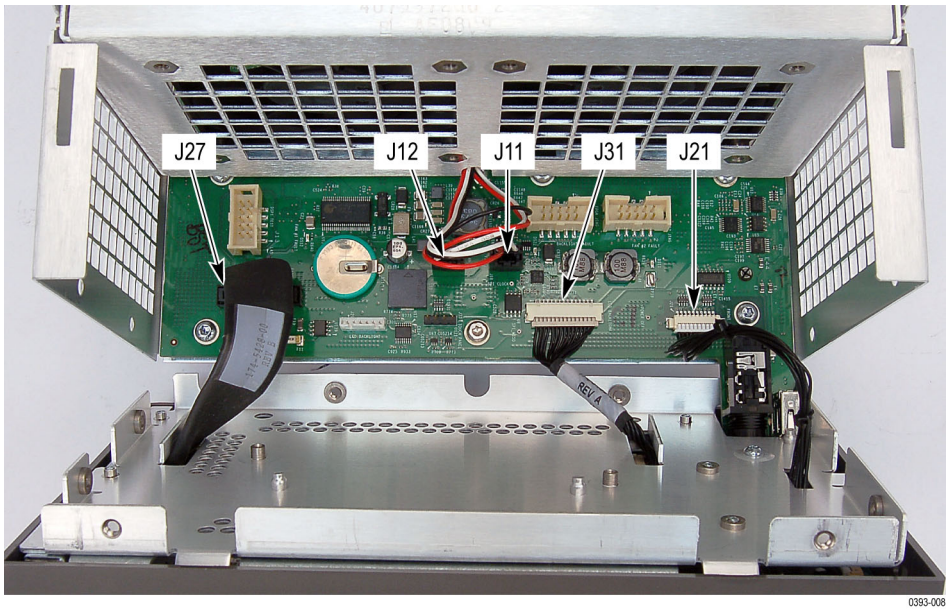

Figure 7: Front panel and fan cable connections

Remove the bezel from the LCD assembly. Remove to bezel from the front panel assembly to access the front panel board. (See Figure 8 on page 44.)

4. Remove the two T-10 screws that secure the LCD Assembly to the display bracket.
5. Use a Phillips screwdriver to remove the two Pozidriv screws securing the bottom of the bezel to the display bracket.
6. Tilt the bottom of the display bracket up and slide the display brackets out from underneath the bezel clips, leading the front panel cable through the cutout in the bracket.

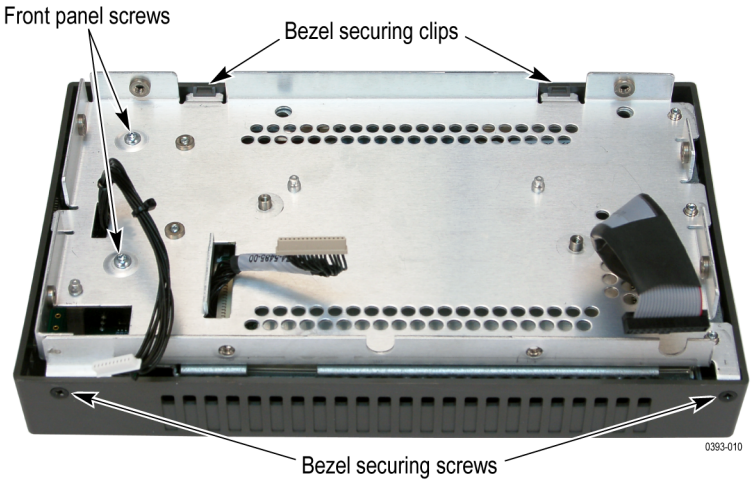

Figure 8: Front panel disassembly

Remove the front panel board from the bezel. The front panel board can be removed from the bezel and replaced, if needed. (See Figure 9 on page 45.)

1. Remove the three knobs from the front panel.
2. Remove the one T-10 screw that secures the front panel to the bezel.
3. Use a $^{3}/_{16}$ inch nutdriver to remove the two jackscrews that secure the front panel board to the bezel.
4. Lift the front panel board away from the bezel.

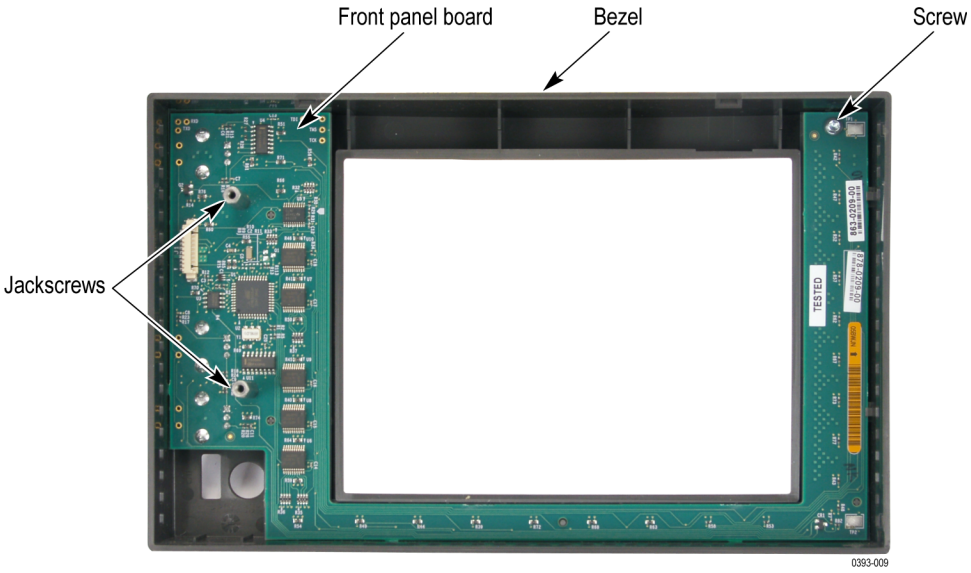

Figure 9: Front panel board removal

Main Board

You will need to remove all of the rear panel modules, the power supply, and the front panel before removing the main board. The main board is the largest board in the instrument and spans the length and width of the chassis bottom.

1. Remove all of the rear panel modules, the power supply, and the front panel.
2. Use a $^{3}/_{16}$ inch nutdriver to remove the 6 jackscrews from the rear panel: two from the Remote connector, two from the Pix Mon connector, and two from the Ext Display connector.
3. Remove the special nuts securing the three BNC connectors to the rear panel.

NOTE. *Special nuts are used on the BNC connectors due to the close physical spacing, and a special tool is needed to remove them. (See Table 8 on page 39.)*

4. Remove the eleven T-15 screws that secure the main board to the chassis.

5. Grasp the main board from the front of the instrument, tilt it up slightly, and then pull it toward you, clearing the rear panel BNCs and connectors and removing the main board from the chassis.

Repackaging Instructions

This section contains the information needed to repackage the instrument for shipment or storage.

Packaging

When repacking the instrument for shipment, use the original packaging. If the packaging is unavailable or unfit for use, contact your local Tektronix representative to obtain new packaging. Refer to *Contacting Tektronix* on the back of the Title page for the mailing address, the email address, and phone number.

Seal the shipping carton with an industrial stapler or strapping tape.

Shipping to the Service Center

Contact the Service Center to get an RMA (Return Material Authorization) number, and any return or shipping information you may need.

If the instrument is being shipped to a Tektronix Service Center, enclose the following information:

- The RMA number.
- The owner's address.
- Name and phone number of a contact person.
- Type and serial number of the instrument.
- Reason for returning.
- A complete description of the service required.

Mark the address of the Tektronix Service Center and the return address on the shipping carton in two prominent locations.

Replaceable Parts

This section contains a list of the replaceable modules for your instrument. Use this list to identify and order replacement parts. Note that not all parts listed in this section are present on every model. The parts present will depend on the model and options installed.

Parts Ordering Information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix products are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If you order a part that has been replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

Module Servicing

Modules can be serviced by selecting one of the following three options. Contact your local Tektronix service center or representative for repair assistance.

Module Exchange. In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-833-9200. Outside North America, contact a Tektronix sales office or distributor; see the Tektronix Web site for a list of offices: www.tektronix.com.

Module Repair and Return. You may ship your module to us for repair, after which we will return it to you.

New Modules. You may purchase replacement modules in the same way as other replacement parts.

Using the Replaceable Parts Lists

This section contains lists of the mechanical and/or electrical components that are replaceable for your instrument. Use this list to identify and order replacement parts. The following table describes each column in the parts list.

Parts list column descriptions

Column	Column name	Description
1	Figure & index number	Items in this section are referenced by figure and index numbers to the illustrations that follow. Orderable modules show the figure number without an index number.
2	Tektronix part number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entry indicates the part is good for all serial numbers.
5	Qty	This indicates the quantity of parts used.
6	Name & description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.

Abbreviations

Abbreviations conform to American National Standard ANSI Y1.1-1972.

Table 10: Circuit boards and connectors (See Figure 10.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-1					**Circuit Boards and Connectors**
-1	671-5764-04			*	CIRCUIT BD SUBASSY; ANALOG AUDIO OPTION BD
-2	671-6478-00			*	CIRCUIT BD SUBASSY; AUDIO MAIN OPTION BD, SAFETY CONTROLLED
-3	119-7167-00			*	CIRCUIT BD ASSY; CAT552 DOLBY E/DIGITAL DECODER MODULE; 72 PIN SIMM; SAFETY CONTROLLED
-4	870-0189-00 Option PHY3			1	CIRCUIT BD SUBASSY; 3G-EYE; TESTED
	870-0196-00 Option SDI			1	CIRCUIT BRD ASSY;SDI,UNTESTED,3893982XX, ,ROHS COMPLIANT
-5	870-0258-00			1	CIRCUIT BD SUBASSY; COMPOSITE, 389-4150-00 WIRED, ROHS COMPLIANT
-6	131-7881-00			1	CONN,IO; PCB,USB,SERIES A;FEMALE,RTANG ON EDGE,1 X 4, 2.5MM CTR,13.90 H X 2.0 TAIL,30 GOLD,W/BOARD RETENTION
-7	131-7717-00			1	CONN,JACK PHONE; PCB/PNL;FEMALE,RTANG,3 POS,4 TERM
-8	870-0109-01			1	CIRCUIT BD ASSY; MAIN, TESTED, 3893980xx WIRED, ROHS COMPLIANT
-9	119-7522-00			1	POWER SUPPLY; 130W, AC-DC;90-264VAC 47- 440HZ IN, DC-DC 117 - 300VDC IN, OUTPUTS +5V@26A, +12V@0.5A, +5V@0.50A STANDBY, REMOTE INHIBIT: ACTIVE PFC;OPEN FRAME, 5X 3.0 X 1.3; UL, CSA, TUV, ROHS, SAFETY CONTROLLED
-10	407-5373-00			1	BRACKET;POWER SUPPLY;SAFETY CONTROLLED
-11	174-5791-00			1	CA ASSY,SP; HV,BR,15.00 L & 4.00 L;CONN EACH END;LINE FILTER TO PWR SUPPLY, SAFETY CONTROLLED
-12	441-2575-00			1	CHASSIS, MODULE
-13	134-0246-01			*	PLUG,HOLE COVER; BUTTON PLUG,;0.578 HEAD DIA X 0.406 THK,ACCOM 0.5 DIA HOLE,0.015-0.125 THK PNL,NYLON,BLACK,94V-2;
-14	210-0457-00			1	NUT,PL,ASSEM WA; 6-32 X 0.312,STL CD PL,W/LOCKWASHER, STEEL, ZINC FINISH
-15	211-0119-00			2	SCREW, MACHINE; 4-40 X 0.25, FLH, 100 DEG, STEEL, BLACK ZINC, POZ
-16	131-4131-00			1	CONN,PLUG,ELEC; MALE W/LOCKING ADPTR,EXT MTG,SAFETY CONTROLLED
-17	211-0734-00			4	SCREW,MACHINE; 6-32 X 0.250,FLH100,STEEL,ZINC FINISH,T-10 TORX DR
-18	119-7086-00			1	FILTER,EMI; AC LINE CONNECTOR/INPUT FILTER;6.0A,120-250VAC,DC-400 HZ,2.2 NF CY,100 NF CX,IEC INPUT,FAST-ON/SOLDER LUG OUTPUT,CHASSIS MOUNT,SAFETY CONTROLLED;FN9222-6/06
-19	211-0950-00			4	SCREW, MACHINE; M2X.4X3L, PHL, PNH, STEEL, ZINC FINISH
-20	220-0497-00			7 *	NUT,PLAIN,HEX; 0.5-28 X 0.562 HEX,BRS NI (NICKEL) PLATED
-21	210-1039-00			27 *	WASHER,LOCK; 0.521 ID,INT,0.025 THK, STEEL, ZINC FINISH
-22	214-3903-00			6	SCREW,JACK; 4-40 X 0.312 LONG,0.188 H HEX HEAD STAND OFF,4-40 INT THD, X 0.312 THD EXT 4-40
-23	211-0722-00			11	SCREW,MACHINE; 6-32 X 0.250,PNH,STL,CDPL,T-15 TORX DR
-24	131-7721-00			1	CONN,JACK; PCB/PNL,RJ45,CAT5E,W/LEDS YELLOW & GREEN/ORANGE,FEMALE,RTANG,8 POS,0.100 CTR,0.517 H X 0.13 TAIL,10/100/1000 BASE TX AND RX MAGNETICS MODULE, 30 GOLD, SAFETY CONTROLLED
-25	131-8089-00			1	CONN, DVI-I, FEMALE, RTANG, PANEL MOUNT

Table 10: Circuit boards and connectors (See Figure 10.) (cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
-26	131-8271-00			3	CONN, RF, PLUG, BNC, FEMALE, RTANG, 75 OHM, SMT CENTER PIN, HIGH BW AND RETURN LOSS, LOW PROFILE, 0.515 TALL, 0.275 CENTER OFFSET, 30 GOLD
-27	211-0722-00			10 *	SCREW,MACHINE; 6-32 X 0.250,PNH,STL,CDPL,T-15 TORX DR
-28	131-3378-00			4	CONN,RF,JACK; BNC,50 OHM,FEMALE,RTANG,PCB/REAR PNL,0.5-28 THD,0.625 H X 0.187 TAIL,W/O MTG FLANGE,W/MTG POSTS,METAL BODY
-29	333-4593-00			2	REAR PANEL, SAFETY CONTROLLED, STD (SDI)
-30	131-7582-00			1	CONN,DSUB; PCB;FEMALE,RTANG,DUAL STACKED,15 POS HD LOWER,9 POS UPPER,SAFETY CONTROLLED
-55	333-4592-00			1	REAR PANEL, SAFETY CONTROLLED, 3GEYE
-31	131-7564-00			4	CONN,RF PLUG; DUAL STACKED BNC,PCB,PNL MNT,FEMALE,RTANG,75 OHM, ZINC DIE CAST HOUSING
-32	131-M057-00			4	CONN,RF:PCB,FEMALE,BNC,75OHM,EDGE LAUNCH TYPE
-33	220-0271-00			8	SPANNER NUT AND LOCKWASHER
-34	210-0410-00			2 *	SCR,ASSEM WSHR; 4-40 X 0.437,PNH,STL,CDPL,T-10 TORX DR (STD)
	214-3903-00			2 *	SCREW,JACK; 4-40 X 0.312 LONG,0.188 H HEX HEAD STAND OFF,4-40 INT THD, X 0.312 THD EXT 4-40 (OPT AD OR DPE ONLY)
-35	333-4489-01			1	PANEL, REAR; AUDIO OPTION
-36	200-4800-00			1	COVER,MINI; 2X FEX-440,SAFETY CONTROLLED
-37	131-7272-00			1	CONN, DSUB; PCB/PNL, FEMALE, 62 POS, RTANG, 0.100 CTR, 0.495 H X 0.125 TAIL, 30 GOLD, 4-40 THD INSERTS, BOARD RETENTION, HIGH DENSITY CONN
-39	174-5653-00			1	CABLE ASSEMBLY; POWER SUPPLY, HIGH CURRENT
-40	131-6521-00			4	CONTACT,ELEC; EMI,CLIP-ON,0.38 L X 0.500 W (2 CONTACTS) X 0.45 H,ELECTROLESS NICKEL PLATE

* Quantity will vary depending on instrument model and installed options.

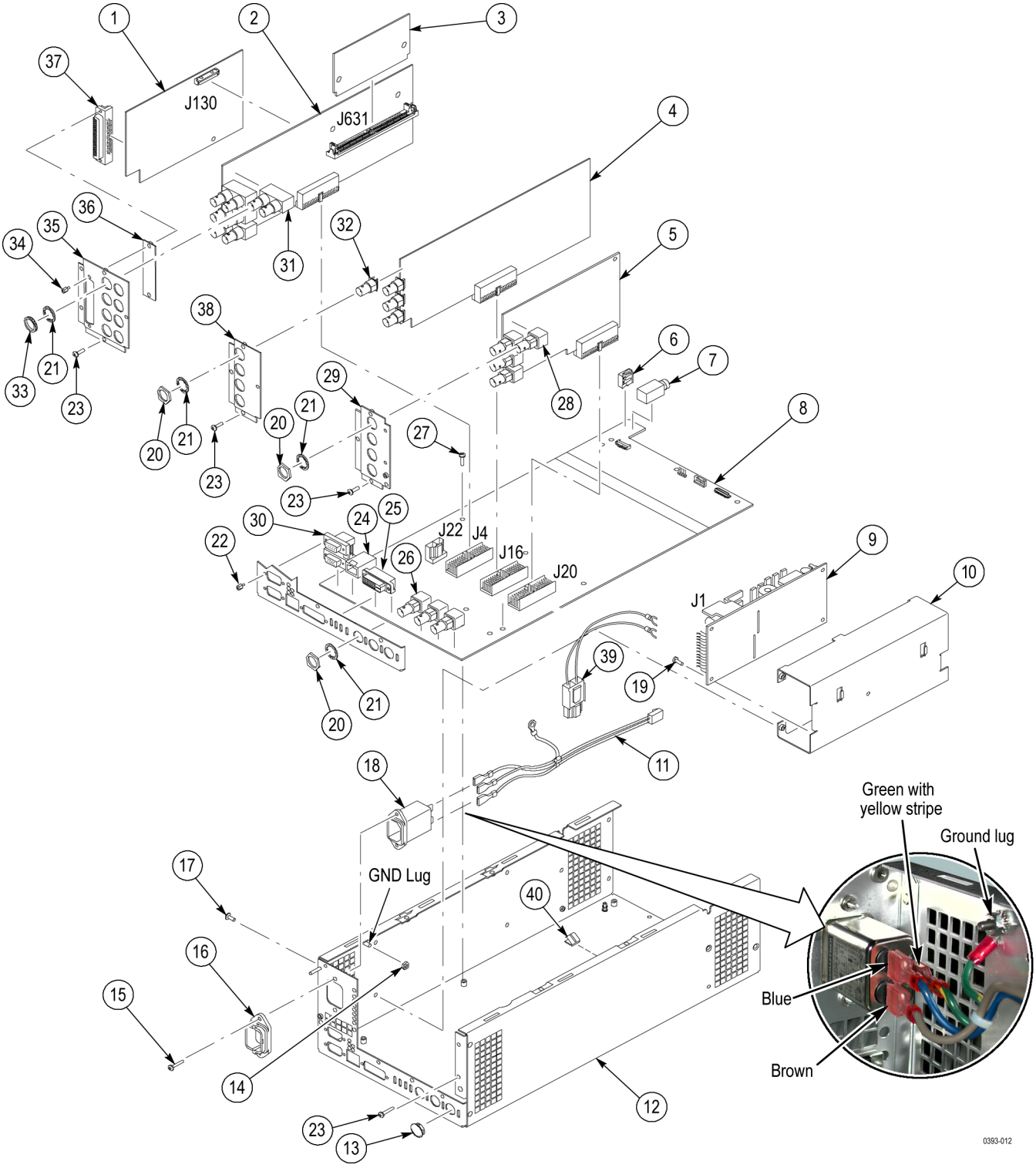

Figure 10: Circuit boards and connectors

Table 11: Chassis components (See Figure 11.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-2					Chassis Components
-1	200-5100-00			1	COVER, TOP CHASSIS; SAFETY CONTROLLED
-2	386-7435-00			2	SUPPORT, CIRCUIT BOARD
-3	211-0734-00			18	SCREW,MACHINE; 6-32 X 0.250,FLH100,STL,CDPL,T-10 TORX DR
-4	211-1117-00			2	SCREW,MACHINE; 4-40 X 0.187,PAN HEAD,STL,CD PL,T-10,TORX DR
-5	850-0126-00			1	BEZEL ASSEMBLY, FRONT PANEL; CONTROLLER
-6	129-1636-00			2	SPACER POST: 4-40M/F,0.687L,SST,0.188HEX
-7	863-0209-00			1	CIRCUIT BD SUBASSY;389410200;FP; ROHS COMPLIANT
-8	850-0125-00			1	FRAME; FRONT BEZEL,PC/ABS,TV GRAY, SAFETY CONTROLLED
-9	366-0859-01			3	ASSEMBLY, KNOB; .470 DIAMETER, SOFT TOUCH
-10	174-5652-00			1	CABLE ASSEMBLY; POWER SUPPLY, 10 PIN
-11	174-5428-00			1	CA ASSY; SHIELDED RIBBON ADAPTER TO XGA LCD DISPLAY, 20 PIN
-12	174-5485-00			1	CABLE ASSEMBLY DISPLAY INVERTER; 15 PIN; LED BACKLIGHT TO DISPLAY
-13	119-6554-00			2	FAN ASSEMBLY; 12V; 0.11A 1.3W, 28CFM, 2450RPM, 27DBA, 80MM SQ X 20MM); 6 IN, 3 LEAD WITH CONN, UL, CSA, VDE, SAFETY CONTROLLED
-14	407-5372-00			1	BRACKET; FAN MOUNTING, SAFETY CONTROLLED
-15	211-1050-00			8	SCREW,MACHINE; 6-32 X 0.312 L,PNH,STL CAD PLT,T15
-16	850-0124-00			1	FINAL ASSEMBLY; LCD DISPLAY MODULE; TESTED
-17	214-5152-00			1	SPRING,CLIP; EMI

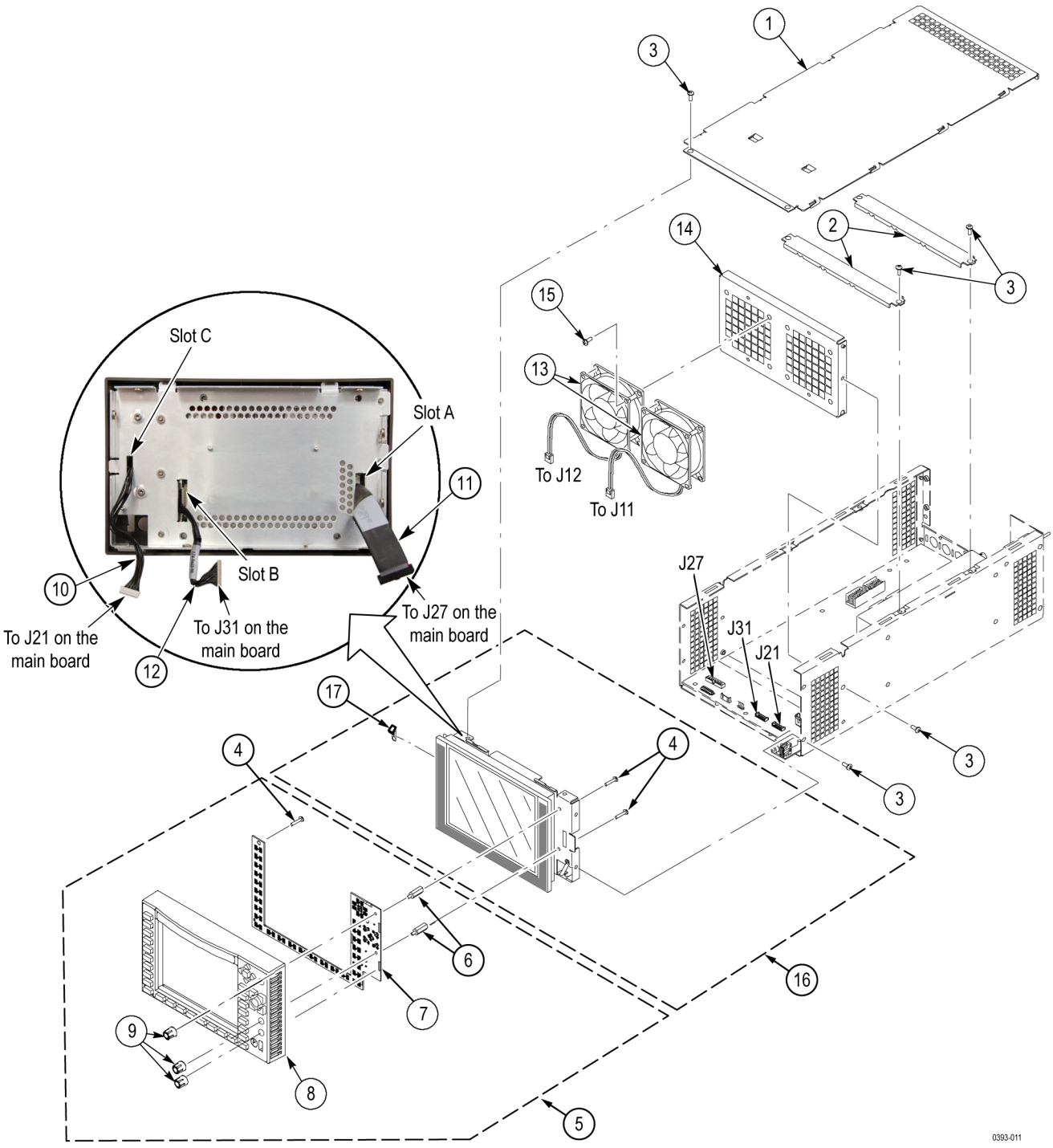

Figure 11: Chassis components

Table 12: Replaceable parts list (See Figure 12.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-3					**Main Board**
-1	159-5022-00			8	FUSE; 5.0A,125V;FAST BLOW,0.1 X 0.1 X 0.24,UL REG,CSA CERT;451005,SAFETY CONTROLLED
-2	260-5015-00			1	SWITCH, PUSH; SPST, TACT;50MA, 50V, MOMENTARY, SILVER CONTACTS;KSC221G, GULLWING SMD
-3	159-5018-00			1	FUSE; 3.0A,125V,FAST BLOW,0.1 X 0.1 X 0.24,UL REG,CSA CERT,SAFETY CONTROLLED
-4	159-5003-00			1	FUSE,THRM,CHIP; SELF RESETTING FUSE,1.1A HOLD,2.2A TRIP AT 20 DEG C,30V MAX,SAFETY CONTROLLED
-5	159-5014-00			1	FUSE; 2.0A,125V,FAST BLOW,0.1 X 0.1 X 0.24,UL REG,CSA CERT,SAFETY CONTROLLED
-6	260-5015-00			1	SWITCH,DIP; SPST,SLIDE,DIP,4 POSITION,GOLD OVER NICKEL,0.4VA @ 20VDC,0.05 HALF PITCH;TD04H0SK1,SMD
-7	146-0109-00			1	BATTERY,DRY; 3.0V,LITHIUM MANGANESE DIOXIDE,210MAH,20 X 3.22MM COIN CELL WITH SOLDER TABS,CR2032-1HF1
-8	131-7107-00			1	CONN, HDR; SMD,MALE,RTANG,1 X 10,0.049 CTR

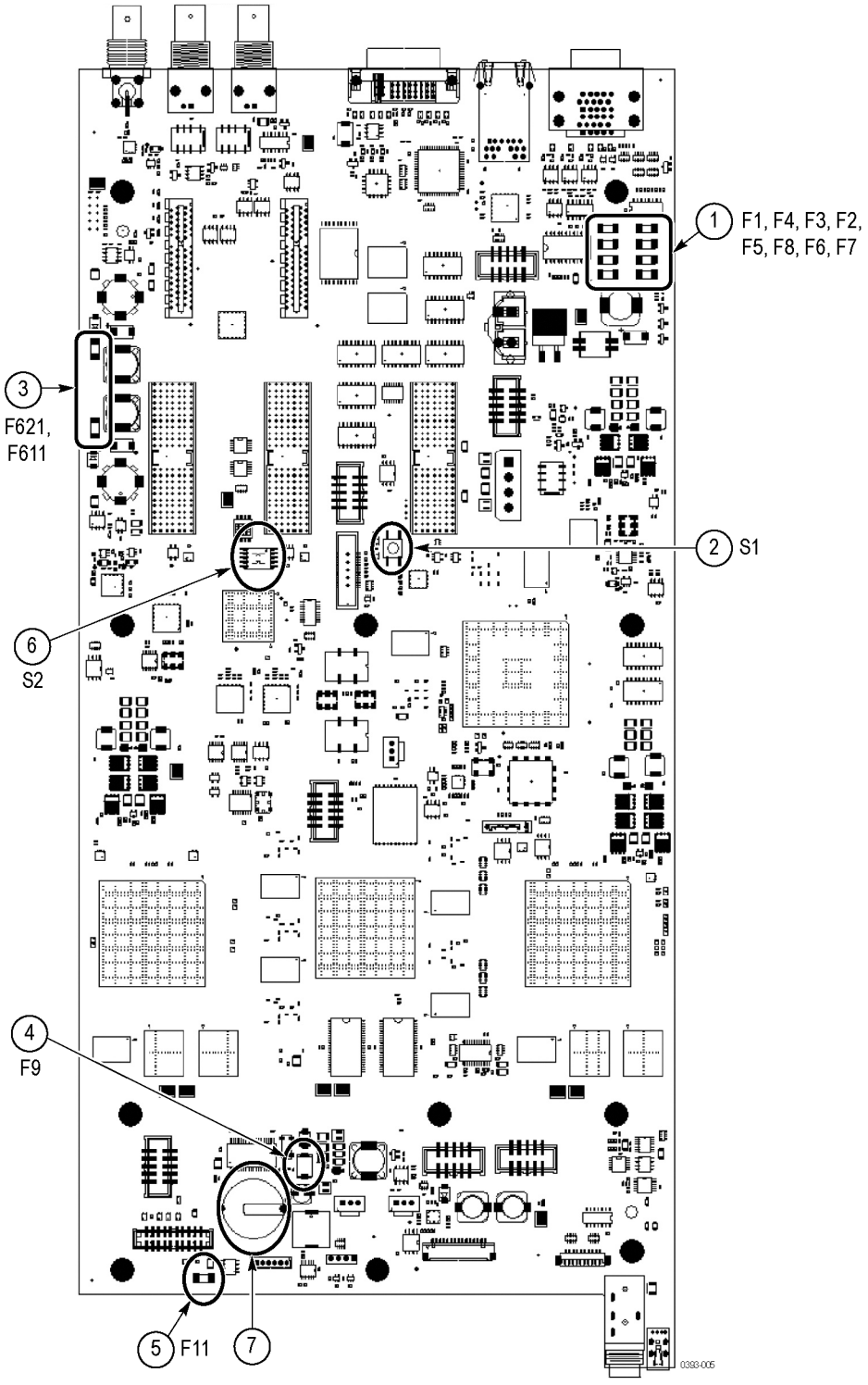

Figure 12: Main board replaceable components

Table 13: Replaceable parts list (See Figure 13.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-4					**ANALOG AUDIO BREAKOUT CABLE** ***Note: Optional Accessory***
-1	012-1688-00			1	CABLE ASSEMBLY; ANALOG/AUDIO BREAKOUT
-2	200-4804-00			1	COVER; SHIELD,ELEC CONN,37 POS DSUB,ZINC
-3	131-0422-00			1	CONN,DSUB; SLDR CUP/PNL,;MALE,STR,37 POS,0.112 CTR,0.186 H X 0.126 TAIL,0.125 DIA THRU MTG

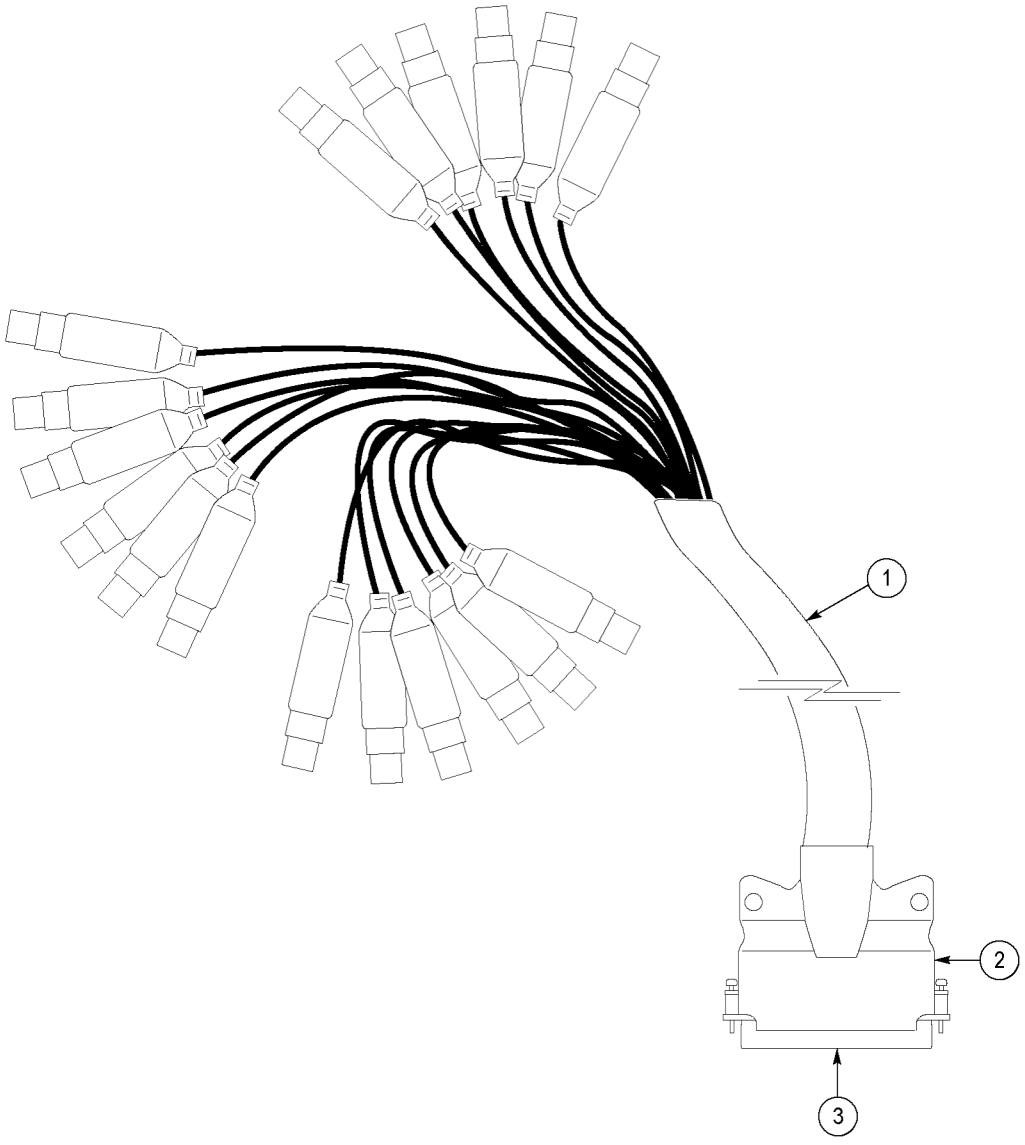

Figure 13: Analog audio breakout cable assembly

Table 14: Accessories

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
					Standard Accessories
	071-3023-xx (Subpart of 020-3005-xx)			1	PRINTED MANUAL,TECH; SAFETY AND INSTALLATION INSTRUCTIONS, ENGLISH, JAPANESE, SIMPLIFIED CHINESE
	077-0667-xx			*	MANUAL,TECH; USER, ENGLISH
	077-0673-xx			*	MANUAL,TECH; RELEASE NOTES
	077-0669-XX			*	MANUAL,TECH; SPECIFICATIONS AND PERFORMANCE VERIFICATION TECHNICAL REFERENCE
	077-0391-XX			*	MANUAL,TECH; SYSTEM INTEGRATION INSTRUCTIONS
	077-0261-xx			*	MANUAL,TECH; MANAGEMENT INFORMATION DATABASE (MIB) PROGRAMMER
	063-4427-xx (Subpart of 020-3102-xx)			1	DOCUMENTATION; PRODUCT CD
	See Description			1	CABLE ASSY, POWER:
					Option / *Country* / *P/N*: A0 / N. AMERICA / 061-0066-00; A1 / UNIV EURO / 161-0066-09; A2 / UK / 161-0066-10; A3 / AUSTRALIA / 161-0066-13; A4 / USA 240 V / 161-0066-12; A5 / SWITZERLAND / 161-0154-00; A6 / JAPAN / 161-0298-00; A10 / CHINA / 161-0304-00
					Optional Accessories
	650-4393-XX (WFM7F02)				CABINET; PORTABLE CABINET WITH HANDLE,FEET,TILT BAIL AND FRONT PANEL COVER
	200-4716-00				COVER,FRONT; PROTECTIVE,PC/ABS FR110,TV GRAY
	650-4445-XX (WFMRACK-NN) 650-4394-XX (WFMRACK-ON)				RACK ADAPTER; DUAL SIDE BY SIDE
	012-1688-00				CABLE ASSEMBLY; ANALOG/AUDIO BREAKOUT